PROCEDURE FOR PREPARING AN EMISSION SUMMARY AND DISPERSION MODELLING REPORT

GUIDANCE FOR DEMONSTRATING COMPLIANCE WITH :

SECTION 5 OF
REGULATION 346
GENERAL -- AIR POLLUTION R.R.O. 1990
MADE UNDER THE ENVIRONMENTAL PROTECTION ACT

June 1998

Ontario

Ministry of the Environment

Revised: 2002/11/21

PIBs #3614-01

TABLE OF CONTENTS

103-06457/

1. **REGULATION 346** 1
   1.1. Section 5, Dispersion Based Limit 1

2. **EMISSION SUMMARY AND DISPERSION MODELLING REPORT CHECKLIST** 2

3. **FACILITY DESCRIPTION** 3

4. **SOURCE SUMMARY TABLE** 3
   4.1. Source Identifier and Description 5
   4.2. Source Data 7
   4.3. Maximum Emission Scenario 8
   4.4. Annual Emission Scenario 9
   4.5. Emission Rate and Estimation Technique 9
      4.5.1. Mass Balance Calculations 10
      4.5.2. Emission Factors 11
      4.5.3. Source Measurement 14
      4.5.4. Engineering Calculations 15
   4.6. Data Quality 15
      4.6.1. Emission Factor Data Quality 16
      4.6.2. Source Measurement Data Quality 17
      4.6.3. Mass Balance and Engineering Calculations Data Quality 17
   4.7. Percentage of Overall Emission 20

5. **DISPERSION CALCULATIONS:** 20
   5.1. Virtual Source 21
   5.2. Point Source 23
   5.3. Single Dispersion Sources 23
   5.4. Complex Modelling Scenarios 24
   5.5. Self Contamination 25
   5.6. Regulation 346 Dispersion Modelling Package 26
   5.7. Documentation Required for Dispersion Calculations 26

6. **EMISSION SUMMARY TABLE** 27
   6.1. Point of Impingement Concentration 29
   6.2. Percentage of Criteria 29

LIST OF TABLES **Page**

Minimum Requirements 2
Source Summary Table 4
Estimation Techniques 9
Emission Summary Table 28
Modelling Package Table 26

APPENDIXES

A Summary of Point of Impingement Standards, Ambient Air Quality Criteria (AAQC), and Approvals Screening Levels (ASLs)

B Description of Programs in the Regulation 346 Dispersion Modelling Package

C Case Study I

D Case Study II

E Case Study III

F Emission Summary and Dispersion Modelling Checklist

INTRODUCTION:

This document the "*Procedure for Preparing an Emission Summary and Dispersion Modelling Report*" (Procedure) provides directions on how to develop an emission summary and perform dispersion calculations for the purpose of demonstrating compliance with Section 5 of Regulation 346 under the *Environmental Protection Act*. This document is designed to assist the individual who is responsible for demonstrating compliance with Regulation 346 along with setting minimum requirements for the format and quality of the emission summary.

Section 5 of Regulation 346 - General Air Pollution is applicable to all sources of air pollution in Ontario. However there are circumstances where demonstrating compliance with Section 5 of Regulation 346 may be explicitly required including the following:

- to demonstrate compliance with the Standardized Approval Regulation for modifications to air emission;
- to support an application for approval under Section 9 of the *Environmental Protection Act*;
- for voluntary initiatives promoted or supported by the Ministry of Environment for which compliance with existing regulatory requirements must be demonstrated;
- to support the programs initiated by companies that have Environmental Management Systems in place that require the demonstration of compliance with regulatory requirements;
- as part of an abatement programs required by the Ministry of the Environment staff to address facilities where air pollution is an issue.

It is a requirement of this procedure that emissions be calculated and reported based on maximum half-hour peak emissions from a facility, however the reporting of yearly emissions based on an annual averaging time is also recommended.

The ultimate requirement of this Procedure is that a complete Emission Summary and Dispersion Modelling Report be prepared. The report must be prepared and documented in accordance with the format described by this Procedure. The individual responsible for preparing the Report must be able to defend the accuracy of the data presented in these tables. An Emission Summary and Dispersion Modelling Report is not complete if it is missing any of the following components listed in Section 2 of this document: Submission Checklist, Facility Description (including site plan), a description of the maximum emission scenario on which reported emissions are based, Completed Source Summary Table, Completed Emission Summary Table and Dispersion modelling out-put.

It is strongly suggested studying supplied scenarios Case Studies I, II and III in the Appendix to the Procedure prior to developing a report. The case studies have been designed to illustrate the most common situations encountered and techniques employed in emission summary preparation.

1. REGULATION 346

Regulation 346 R.R.O. 1990 made under the *Environmental Protection Act* is the general regulation governing air pollution in Ontario. Compliance with all applicable Legislation and Regulations is required; this Procedure is intended to address Section 5 of Regulation 346 R.R.O. 1990 made under the *Environmental Protection Act.*

1.1. Section 5, Dispersion Based Limit

Section 5 of Regulation 346 sets limits on emissions based on dispersion modelling. It requires that where a facility emits a contaminant into the air from one or more sources, the concentration in the atmosphere resulting from that pollutant being emitted must be less than the prescribed criteria. As Regulation 346 is currently structured, three key components need to be considered: emission summary (what a facility emits to the atmosphere); dispersion modelling (prediction of how the emitted material is diluted as it moves through the atmosphere); and the appropriate limit on the concentration of the contaminant in the atmosphere.

The person preparing an emission summary is required to generate pollutant emission rate data to combine with the dispersion modelling to predict the concentration at a point of impingement (POI Concentration). The predicted POI concentration from the modelling is compared with the corresponding Half-hour Point of Impingement Limit. Compliance with Regulation 346 is achieved when the maximum concentration at a point of impingement during any half-hour period is demonstrated to be below the applicable limit.

The POI concentration must be calculated for the aggregate emission of a given contaminant, this means that, for a given contaminant, all sources including periodic releases must be assessed. The requirement for a maximum concentration means that the Emission Summary Table described by this procedure must be based on the scenario under which the overall emission is a maximum.

The emission rates used in dispersion modelling shall be the aggregate maximum half-hour average emission rates from all sources of that contaminant occurring during the maximum emission scenario. Each and every source at the facility shall be considered regardless of when a source was installed or whether or not approval under Section 9 of the *Environmental Protection Act* was obtained for that source.

The quality of an emission estimate will influence the confidence with which compliance can be assessed. It is therefore necessary that the emission summary address the accuracy of the emission rate estimate. In general, the individual responsible for preparing the emission summary must be able to defend the accuracy of the data presented in the Emission Summary and Dispersion Modelling Report.

In the Appendix to Regulation 346 there is a description of a series of calculations that describe how a pollutant disperses in the atmosphere. The dispersion models predict the concentration of a contaminant based on critical physical features of the source of emission and the emission rate itself. The concentration is assessed at a Point of Impingement (POI) which is defined as any point on the ground or on a receptor, such as nearby buildings, located outside the company's property boundaries at which the highest concentration of a contaminant caused by the aggregate emission of that contaminant from a facility is expected to occur. Dispersion modelling is explained in detail in Section 5. of this Procedure. A dispersion modelling software package titled *Regulation 346 Dispersion Modelling Package* is made available free of charge by this Ministry.

The POI criteria are listed in the document prepared by the Ministry of the Environment and titled *Summary of Point of Impingement Standards, Ambient Air Quality Criteria (AAQC), and Approvals Screening Levels (ASLs).* The last printing of this document at the date of this guideline is dated June 1994 and it is updated from time to time (attached as Appendix A). The criterion to be used is the Half-hour Point of Impingement Limit which is listed in units of micrograms per cubic metre (ug/m^3). It is important to note that often the criteria listed in the document are specific to a contaminant rather then a general class of contaminants. For example, there is a limit for xylenes (2300 ug/m^3) and toluene (2000 ug/m^3) but not a limit for "petroleum based solvents" or "volatile organic compounds".

2. EMISSION SUMMARY AND DISPERSION MODELLING REPORT CHECKLIST

All Emission Summary and Dispersion Modelling Reports must include a completed copy of an Emission Summary and Dispersion Modelling Checklist, a copy of the double sided check list is included as Appendix F of this procedure. **If any of the items listed in the checklist are not submitted the report is not acceptable.** The minimum requirements of the checklist are as follows:

1.	Facility Description (including site plan):
2.	Completed Source Summary Table (The emission rates, estimation technique and data quality must be identified for all sources and contaminants)
3.	Completed Emission Summary Table
4.	Dispersion modelling out-put
5.	The maximum emission scenario on which reported emissions are based.

Table 1

3. FACILITY DESCRIPTION

The Emission Summary and Dispersion Modelling Report shall include the following information:

- a general description of the facility;
- a process flow diagram detailing the production steps at the plant (this diagram should identify each source);
- a site plan (top or plan view), drawn to scale, showing the locations of all emission sources and all property lines;
- an elevation view (side view) of the facility showing the elevations above grade of all the relevant buildings, an elevation view is not requisite if the heights above grade of all the buildings are clearly identified in the plan view;
- if any of the emission stacks are configured as a Point Source, (see Section 5.2 of this document) the following information is also required: the locations of nearby neighbouring buildings, the height of those buildings and the location of any air intakes or openable windows on those buildings.

4. SOURCE SUMMARY TABLE

The following Table 2 is included as an example to illustrate the required format. It is not a requirement to use an exact copy of the example Table. The requirements of each column of the table are described in the following sections.

The report shall contain the following information on an Source Summary Table:

- source data, including an identifier and a listing of general information on the exhaust stream and stack for each emission source;
- estimate of the maximum emission rate, for every contaminant emitted, in grams per second based on a half-hour average;
- assessment of data quality;
- reference to the emission estimating technique listed in Table 3;
- percentage of overall emission, which is the percentage ratio of the emission rate from a source to the total emission from all sources of a contaminant at a facility;

Source Summary Table

Source Identifier	Description	Source Data					Emission Data			
		Stack Gas Flow Rate	Stack Diameter	Stack Height Above Grade	Stack Height Above Roof	Contaminant	Emission Rate	Data Quality	Estimation Technique
		(m^3/s) (deg C)	(m)	(m)	(m)		(g/s)		

4.1. Source Identifier and Description

The emission summary must use a reference system identifying each source on a site plan (see Section 3 Facility Description). If there are a large number of sources, a labelling or coordinate system should be used to identify the location of each emission point. Each source must be marked with a unique reference (source identifier).

The emission summary must include an emission rate for each contaminant emitted from all significant sources. A source, for the purposes of this procedure, shall be taken to mean an individual point of emission or a distinct process or area from which emissions may originate. Where multiple stacks or vents arise from a common process, the common process itself may be considered a source rather than the individual points of emission. Where several separate processes, each causing a distinct mixture of pollutants, are discharged to a common stack, each of the original separate processes shall each be considered a source. A process is production step or series of production steps for which the emission rate is calculated based on assessing the process as a whole.

A source associated with an area rather than a distinct point of emission is known as a fugitive source it must be identified as a source and included in the emission summary exercise. Some general sources of fugitive emissions can be considered to be not significant, for example minor sources such as general parking lots or road ways serving a manufacturing facility that may give rise to only total suspended particulate dust emissions are not considered significant and are not required to be included as a source in an emission summary provided reasonable management practices to reduce nuisance dust are implemented (the emission of dust from general parking lots or road ways is considered a source if it is a significant source of a contaminant for which the Half-hour POI Criteria for the contaminant has been set based on health).

However, major sources of total suspended particulate dust are considered to be significant sources. Examples of these major sources include:

- operations with high volumes of traffic on dusty roads;
- facilities which store and reclaim aggregate material in outdoor storage piles;
- operations with uncontrolled evapourative losses from solvents;
- landfills;

Each contaminant emitted from a source must be identified based on the generally available information. In the event that contaminants are emitted in small amounts it is not required that an emission estimate for these contaminants be made if it can be demonstrated that their contribution is not significant when ultimately compared to the relevant Half-hour POI criteria.

In the event that a contaminant for which there is no Half- hour POI criteria is emitted from a source, the estimation of the emission and POI concentration must be performed and reported if based on the generally available information (for example the toxicological data in aM SDS) the resultant POI could cause an adverse effect.

An Emission Summary and Dispersion Modelling Report that ignores the emission of a contaminant from a source (where it can be demonstrated that the generally available information indicates that the emission is significant) may not be accepted.

Examples: Identifying Contaminants

Particulate

A baghouse serving a metal grinding operation emits metal particulate. The aggregate emission of all particulate from the baghouse is considered to be total suspended particulate, in addition the individual emission of the specific metals in the particulate must be considered contaminants. To illustrate further, if the metal particulate being emitted was bronze which is a blend of 75% copper and 25% tin and the net emission from the baghouse was 0.4 g/s; the emission summary should identify the emission rates as follows: total suspended particulate 0.4 g/s; copper 0.3 g/s and tin 0.1 g/s.

Solvents

A surface coating operation employs a solvent-based paint sprayed in a booth equipped with effective paint arresters. The spraying operation minimizes over-spray (small particles of the nonvolatile portion of the paint) by using a high efficiency paint guns and employing paint arresters which are composed of a paper filter that captures 99% of the particulate. The volatile components of the paint will pass through the paint arresters. In this case the volatile contaminants are considered to be emitted and the particulate emission can be considered negligible because it will be very small when compared with the relevant standard. The emission rates must be specified for each specific volatile component of the paint.

Example: Identifying Contaminants

Combustion Products

A combustion source will emit carbon dioxide, nitrogen oxides, sulphur dioxide, carbon monoxide, water, unburned hydrocarbons and particulate. For natural gas combustion the emissions of sulphur dioxide, carbon monoxide, carbon dioxide, water, unburned hydrocarbons and particulate are considered negligible because the impact of their emission is very small when ultimately compared with the relevant standards. Therefore, it is allowable to only identify the nitrogen oxide emission rate. See the example "AP-42 Emission Factors" in Section 4.5.2 for more clarification.

4.2. Source Data

A listing of general information for each emission point, including the following:

- volumetric flow-rate of exhaust gas referenced to the exhaust gas temperature in cubic metres per second (m^3/s);
- stack inner diameter, in metres (m);
- stack height above roof, in metres (m);
- stack height above grade, in metres (m)for facilities where the property elevation varies significantly at the site a reference grade should be identified;

If the emission stack is configured as a Point Source (the point of emission is twice the height of the maximum building height of the structure to which the stack is attached, see Section 5. of this document) the following information is also required:

- exit velocity of the stack gases, in metres per second (m/s)
  {determined from the volumetric flow rate (V) and the stack diameter (D) using $V(m^3/s)/Area(m^2)$ where $Area= \pi D^2/4$};
- stack gas temperature (°C).

4.3. Maximum Emission Scenario

The POI concentration must be calculated for the aggregate emission of a given contaminant, this means that, for a given contaminant, all sources including periodic releases must be assessed. The requirement for a maximum concentration means that the Emission Summary Table must be based on the scenario under which the overall emission is a maximum. The reported emission shall be based on a realistic operating scenario that yields the largest overall emission rate during any half-hour period. It is understood that if it is not possible for all sources to operate simultaneously at maximum output then that scenario is not realistic. **An Emission Summary and Dispersion Modelling Report that does not properly identify the Maximum Emission Scenario may not be accepted.**

Examples: Maximum Emission Scenarios

A manufacturing operation fabricates custom gearboxes. Pollutants are emitted from the following sources: two heat treatment ovens (Sources one and two), a paint booth (Source 3), and a baghouse serving all the metal machining operations (Source 4). The heat treatment ovens are rated at one and four million kilojoules per hour thermal input million, only one oven is used at any given time depending on the product being made, the baghouse operates continuously and the spray booth is used to apply paint at a application rates of one to four litres an hour. The correct maximum emission scenario would be the first heat treatment oven not operating, the second heating oven operating at 4 million kilojoules per hour thermal input, the spray booth operating at 4 litres an hour with emissions from the baghouse being constant.

A printing operation has five lines of various capacities. Lines one, two and three are all have a 100 centimetre web (printing width), printing up to five colours at a maximum line speed of 10 metres per second , while Lines four and five are 80 centimetre web , three colour lines operating at 5 metres per second. The cleaning of a print line will also result in emissions since a significant volume of solvents is used, however the cleaning emissions are lower than the emissions from an operating line. Each line requires half a shift to clean and set up for a print run and the production schedule and plant staffing level dictate that only three lines can be operated simultaneously. The correct maximum emission scenario would be that the three largest lines all operate at maximum line speed with five colours while one of the smaller lines was being cleaned and the other smaller line was not in production.

4.4. Annual Emission Scenario

The stated purpose of this procedure is to demonstrate compliance with Section 5 of Regulation 346 which requires half-hour averaging times for emissions. However, it is recommended that annual emission rates be calculated as well.

An annual emission number will be based on the same emission estimation principles and techniques employed for the peak emission but will employ an annual average emission scenario to generate the overall emission rate.

4.5. Emission Rate and Estimation Technique

An emission rate must be developed for each contaminant emitted from each source. This emission rate must correspond to some peak operating parameter or maximum production rate.

The emission rate can be calculated based on:

- a mass balance over the system;
- published emission factors;
- direct measurement of the source;
- any other scientifically valid method that can accurately represent the actual emission rate, such as: an engineering estimate based on operating conditions, literature data, thermodynamic and physical properties.

The approaches listed above are described in the four categories listed in Table 3. In order for an emission summary to be acceptable it must identify which of these categories the estimate falls into. For each emission estimate the estimation technique must be identified and supporting calculations including documentation of all assumptions must be included.

Estimation Techniques

Reference	Estimation Technique
MB	Mass Balance Calculations
EF	Emission Factor Calculations
SM	Source Measurement
EC	Engineering Calculations

Table 3

Emission rates must be reported based on a half-hour averaging time. The person preparing the emission summary is expected to use a reasonable averaging reflecting the time the actual process is in operation.

Example: Averaging Time

A source emits 1 kilogram continuously over a two-hour period each day and emits nothing during the balance of the day. The emission rate would be 250 grams per half hour or 0.14 grams per second. It is not correct to average the emission over the length of a shift or over a 24-hour day.

In the case where the emission takes place over less than half an hour it is permissible to average over the half-hour, for example if a source emitted 100 grams in a 10 minute interval but emitted nothing for the next 24 hours the instantaneous emission rate would be 0.167 grams per second but it is permissible to average the total 100 gram emission over 30 minutes to get 0.056 grams per second emission rate on a half-hour basis.

4.5.1. Mass Balance Calculations

A mass balance is an accounting of the material that enters and leaves from a process or reaction. Many processes involve the addition of a variety of raw materials which make up a product with some losses which include emissions to the atmosphere. A proper mass balance must account for the fate of **all** the process ingredients.

Example: Mass Balance of Dip Tank

A surface coating operation uses a dip tank that contains varnish to coat wood components. The varnish is 25% toluene, there are no other volatile components. The tank is used constantly for four hours each week. Before the tank is used, it is filled up to its working level. For each four-hour cycle the total make-up of varnish added to the tank is no more than 40 litres. The net input of solvent in the process is the amount of solvent added into the tank. The net output is the solvent that evaporates off the wood components and tank surface. Therefore, by assuming 100% of the solvent evaporates, the emission rate would be 25% toluene x 40 litres of varnish emitted over four hours. Thus, 10 litres of toluene is emitted during four hours. One litre of toluene weighs 800 grams. Therefore, the emission rate can be calculated to be 0.56 grams per second {(10 litres x 800 grams)/(4 hours x 60 minutes x 60 seconds)}.

4.5.2. Emission Factors

Emission factors are typically constants which are applied to a process parameter or production rate to generate an emission rate. The most commonly used emission factors are those published by the United States Environmental Protection Agency (USEPA), titled "Compilation of Emission Factors," it is currently in its Fifth Edition and it is subtitled "Volume I: Stationary Point and Area Sources." The document is updated annually with supplements, and a new edition issued every five years. The most recent versions of all chapters in the updated document are available in ZIP or Adobe Acrobat PDF format from the CHIEF (Clearing House for Inventories and Emission Factors) site on the World Wide Web http:/www.epa.gov/ttn/chief)

USEPA emission factors are usually generated from source testing data and are reported as an average. Along with the emission factor, a rating of the quality of the factor is included. This rating ranges from the best rating of "USEPA A" through to the lowest quality of "USEPA E".

There are also emission factors for specific type of process or control equipment based on the equipment rating or capacity. These emission factors could be supplied as part of a manufacturers performance guarantee, a manufacturers guarantee can only be considered a valid emission factor if it is supported by a Source Measurement as defined in Section 4.5.3 of this document. For such a supported emission factor the quality of the factor shall be considered to be equivalent to US-EPA "C".

Example: Baghouse Emission Factor

> A baghouse to control emissions from a sand blasting operation has a maximum volumetric flow-rate of 0.9 cubic metres per second. The baghouse manufacturer has guaranteed an emission factor of 20 mg/m^3 of air supported by a properly documented source test. Therefore, the emission rate is 0.18 g/s.

Example: AP-42 Emission Factor
Secondary Aluminum Processing

A furnace melts clean aluminum scrap and ingot to be formed in a casting operation. The furnace is fired by natural gas fired burner rated at 2,500,000 kilojoules per hour thermal input. The furnace is a crucible design with a melting capacity of 500 kilograms per hour which vents all emissions directly to the atmosphere.

The US-EPA AP-42 Compilation of Air Pollution Emission Factors Volume I: Stationary and Point and Area Sources in Section 7.8 Secondary Aluminum Operations lists a particulate emission factor of 0.95 kg/Mg for an uncontrolled crucible furnace (USEPA emission factor rating "C").

The US-EPA Air Species Manual, Volume 2 Particulate Matter Species Profiles provides the following profile for secondary aluminum processing:

Aluminum Furnace

Contaminant	Species Profile	Contaminant	Emission Rate (g/s)
Aluminum	28.33%	Total Particulate	0.13
Fluoride	5.44%	Aluminum	0.03739
NA	3.57%	Fluoride	0.00718
SO4	3.56%	Sodium	0.00471
Magnesium	2.77%	SO4	0.00470
EC	2.08%	Magnesium	0.00365
Chloride	1.29%	Chloride	0.00170
Calcium	0.48%	Calcium	0.00063
Iron	0.43%	Iron	0.00056
Silica	0.27%	Silica	0.00035
Nickel	0.20%	Nickel	0.00026
Copper	0.07%	Copper	0.00010
Bromine	0.06%	Bromine	0.00008
Vanadium	0.06%	Vanadium	0.00008
Titanium	0.05%	Titanium	0.00007
Zinc	0.01%	Zinc	0.00002

With a melting rate of 500 kg/hr and an emission factor of 0.95 kg/Mg the emission rate of particulate will be: $500/1000 \times 0.950 \times 1000/60^2 = 0.13$ g/s

The species profile indicates what percentage of the total particulate each species represents. The emission rate for each of those species is the total emission rate multiplied by the species percentage.

The US-EPA AP-42 Compilation of Air Pollution Emission Factors Volume I: Stationary and Point and Area Sources in Section 1.4 Natural Gas Combustion provides the following Emission Factors:

Contaminant	Emission Factor ($kg/10^6 m^3$)	Factor Rating
Particulate	16 - 80	B
Sulphur Dioxide	9.6	A
Nitrogen Oxide	1600	A
Carbon monoxide	320	A
Methane	43	C
Non-methane volatile organics	84	C

The US-EPA Air Species Manual, Volume I Volatile Organic Compound Species Profiles provides the adjacent profile for the Non-methane volatile organics emission from natural gas combustion:

Contaminant	Species Profile
Hexane	2.27%
Pentane	20.45%
Propane	9.09%
N-butane	20.45%
N-pentane	13.64%
Cyclohexane	2.27%
Formaldehyde	18.18%
Benzene	9.09%
Toluene	4.55%

There are 37,000 kilojoules per cubic metre of natural gas. Given that the thermal input of the furnace is 2,500,000 kilojoule per hour which results in a natural gas usage of 67.6 cubic metres per hour. Combining this maximum usage rate with the emission factor for particulate results in: $80 \times 1000/10^6/60^2 \times 67.6 = 0.0015$ g/s

Natural Gas Combustion

Contaminant	Emission Rate (g/s)
Particulate	0.0015
Sulphur Dioxide	0.0002
Nitrogen Oxide	0.0300
Carbon monoxide	0.0060
Methane	0.0008
Non-methane volatile organics	
Hexane	0.00004
Pentane	0.00032
Propane	0.00014
N-butane	0.00032
N-pentane	0.00021
Cyclohexane	0.00004
Formaldehyde	0.00029
Benzene	0.00014
Toluene	0.00007

NOTE:

For natural gas combustion there are 14 contaminants listed above however all but nitrogen oxides can be considered negligible because the impact of their emission very small when ultimately compared with the relevant standards. Therefore, it is allowable to only identify the nitrogen oxide emission rate.

4.5.3. Source Measurement

Emission rates can be based on source measurement conducted at the facility that is the subject of the emission summary or source measurement conducted on another similar process. It is imperative that any source testing data be referenced to published source testing protocols. Source measurements must be conducted in accordance with an explicit reference method that has been approved by an appropriate environmental jurisdiction.

Source measurement testing is a comprehensive exercise in which a methodical, documented approach is taken to accurately measure stack flow-rates and to collect and analyse a sample of the emissions so that an emission rate can be calculated. The objective of source measurement is to obtain a representative sample of emissions under conditions which are in turn representative of the process' maximum potential emissions, this is usually at the maximum production rate for the process being tested. The Emission Summary and Dispersion Modelling Report must contain documentation demonstrating that the emission rate generated from the source measurement data is prorated to represent the maximum emission from the source that is being included in the emission summary.

This Procedure does not require that source testing be conducted under the supervision of the Ministry unless otherwise required. If the individual who is conducting the testing wants to seek Ministry concurrence with source testing data then all steps of the program must be reviewed by Ministry personnel before testing. This type of review may be conducted by the Ministry on a case by case basis depending on the circumstances. The Ministry does not commit to reviewing any proposed test programs. However source measurements should be conducted in accordance with the Ontario Source Testing Code and all existing Ministry guidance documents as a matter of due diligence. Where Ministry involvement in the form of review of pre-test plan, witnessing of tests, or report review is not possible, the responsibility rests on whoever is conducting the source measurement to document the program fully to the same extent as for a compliance test.

Where the emission estimate is based on source measurement performed for another jurisdiction such as: Environment Canada, other Canadian provincial agencies, or a state or federal Environmental Protection Agency in the United States the submitted emission rate must include confirmation that the measurements have been accepted by the relevant jurisdiction as representative of the emissions from that source.

Any source testing data must be supported by a source testing report that, as a minimum, contains a copy of the appropriate published reference method protocols, a copy of all field data, a copy of all analytical results and a summary of the emission figures. The individual/s who performed the tests and the date of testing must be clearly identified.

4.5.4. Engineering Calculations

Emissions rates can also be developed from fundamental scientific principles and measurements.

Included in this category of emission estimates are calculations based on direct source measurements that are not done in accordance with explicit referenced protocols as is required in the Direct Source Measurement section of this Procedure.

Example: Volatile Emissions From a Tank

> A tank containing a known mixture of volatile organic materials is periodically vented by a fan. The concentration of the volatile chemicals in the air just above the surface of the tank can be calculated by assuming the air is completely saturated with the volatile chemicals and applying Ideal Gas Laws. This concentration can be multiplied by the maximum rated flow of the fan to yield an emission rate estimate.

4.6. Data Quality

The emissions rates reported in an Emission Summary and Dispersion Report can be used to assess compliance with the regulatory limits in Section 5 of Regulation 346 written under the *Environmental Protection Act.*

Every half-hour averaged emission rate must include some qualification of the uncertainty of the estimation, for the purposes of this procedure the data qualification is referred to as Data Quality.

This uncertainty assessment is necessary to sensibly compare the various sources of a common contaminant and their impact on the point of impingement concentration. The intent of this requirement is to avoid any underestimations that would result in an erroneous argument for compliance. **Any Emission Summary and Dispersion Modelling Report that does not include the Data Quality for an emission estimate may not be accepted.**

There are different ways to report Data Quality depending on the which of the four Estimation Techniques described in this procedure are employed. The following Table 4, describes the acceptable Data Quality for each Estimation Technique. Further clarification is provided in the following discussion.

Acceptable Data Quality

Estimation Technique Employed	Acceptable Data Quality
Emission Factor Calculations	US-EPA emission factor quality rating or equivalent
Source Measurement	"Doc." for documented in accordance with the requirements of Section 4.5.3. (anything less makes the estimation technique an Engineering Calculation)
Mass Balance Calculations	"Con" for conservative, or a quantitative estimate of the uncertainty of the emission rate estimate
Engineering Calculations	"Con" for conservative, or a quantitative estimate of the uncertainty of the emission rate estimate

Table 4

4.6.1. Emission Factor Data Quality

Most emission estimates made with US EPA AP-42 emission factors Emission Factors are non-conservative since emission factors tend to report average emissions rather than maximum emissions. For an estimate based on an emission factor the factor itself must be carefully documented and any associated error reported. Where are employed, the emission rating factor can be quoted as the Data Quality instead of a quantitative error. The emission rating factor is a qualitative measure of the uncertainty of the emission factor with an "USEPA A" rating being highest and a "USEPA E" rating lowest.

In the case of a manufacturer's guaranteed maximum emission rate the explicit guarantee must be clearly supported by a Source Measurement as defined in Section 4.5.3 of this document. For such a supported emission factor the Data Quality of the factor shall be considered to be equivalent to "US-EPA C".

For any other type of emission factor it is possible to report the data quality based on estimating the US-EPA emission factor rating provided sufficient documentation is provided to support the estimation of the quality factor.

4.6.2. Source Measurement Data Quality

As discussed in detail in Section 4.5.3 of this procedure there are specific requirements for documenting an estimate as Source Measurement. If an estimate is based on properly documented source testing it can be considered Source Measurement and the Data Quality can be reported as "Doc. " for documented.

All other types of direct source measurement are considered Engineering Calculations.

4.6.3. Mass Balance and Engineering Calculations Data Quality

In general all Mass Balance or Engineering Calculation can be divided into Conservative and Non-conservative. For the purposes of this Procedure, a Conservative emission estimate is an overestimate for which it can be said that it is extremely unlikely that the emissions will be higher. The Data Quality for a Conservative estimate can be reported as "C" for Conservative.

A Non-conservative estimate is made by treating data in a less than conservative fashion. With this type of estimate it becomes very important to quantify the error so that the Data Quality of the Emission Estimate can be reported.

Conservative Emission Estimates

The reporting of Data Quality can be simplified if a conservative approach to the emission rate is used. Most processes can be analysed using a logical quantitative approach to estimate an emission rate for which it can be said the actual emission would have to be lower. Conservative estimates are those for which it can be said with certainty that the error associated with the estimate is plus zero and minus an unknown quantity.

The Mass Balance approach to estimating an emission rate is considered conservative if all unknown or unquantified losses are assigned as atmospheric emissions and an appropriate averaging time is employed. Therefore, the error estimate on an emission rate can be assumed to be Conservative for rates that are based on mass balances for worst case situations where all the losses are assigned to the emission stream.

In general, any time a calculation is based on one or more conservative assumptions that would lead to an obvious overestimation of the emission, the estimate can be assumed to be Conservative. If a Conservative approach is used, the Data Quality can be reported as "Con." in the Source Summary Table.

Example: Conservative Treatment of Engineering Calculation

An area in a manufacturing facility is used to fabricate custom-made fibreglass reinforced panels. The only volatile component in the resin used is phenol. This area is served by a ventilation system complete with collection hood and discharge fan that exhausts to a stack. The company completed a source testing program that measured the concentration of phenol and the flow-rate in the stack. The testing was undertaken in accordance with a referenced USEPA protocol however the test was not reviewed and accepted by any regulatory jurisdiction therefore the estimate is not considered Source Measurement and is, therefore, an Engineering Estimate for which an assessment of Data Quality must be made. The analysis used was sensitive down to 0.5 mg/m^3 phenol. Of the 10 readings made over several days the average was 12.3 mg/m^3 and the highest was 52.1 mg/m^3. The average measured exhaust gas flow was 1.9 m^3/s and the highest of the was 2.0 m^3/s. This highest concentration of 52.1 mg/m^3 can be multiplied by the 2.0 m^3/s capacity of the exhaust fan to yield a conservative emission rate estimate of 0.10 g/s therefore, the Data Quality can be identified as Conservative..

Non-Conservative Emission Estimates

It is always preferred to use conservative emissions estimates, however it is allowable to use less than conservative emission estimates provided it can be demonstrated that the issue of accuracy is addressed.

More specifically, where non-conservative calculations are used to make an emission estimate, the Emission Summary and Dispersion Modelling Report must include an estimate of the accuracy for that emission estimate and explain why the estimate of the accuracy is valid. The error estimation technique must be described and supporting calculations documenting all assumptions must be included.

Any Emission Summary and Dispersion Modelling Report that does not include the estimate of the error for the Data Quality for an non-conservative emission estimate may not be accepted.

4.7. Percentage of Overall Emission

This figure is the percentage ratio of the emission rate of a contaminant to the overall emission rate of that contaminant from the facility.

Example: Percentage of Overall Emission

> The emissions from a baghouse serving a wood shaping operation are estimated to be 0.038 g/s of particulate, the overall particulate emission from the facility including the baghouse is 0.12 g/s thus the Percentage of the Overall Emission is 32%.

5. DISPERSION CALCULATIONS:

Dispersion models are used to predict how a pollutant dilutes as it moves through the atmosphere. For the purposes of this procedure a dispersion model is used to calculate the maximum concentration of a contaminant at the POI based on critical physical features of the source of emission and the emission rate itself .

The Point of Impingement (POI) is defined as any point on the ground or on a receptor, such as nearby buildings, located outside the company's property boundaries at which the highest concentration of a contaminant caused by the maximum aggregate emission of that contaminant from a facility is expected to occur.

The emission rates used in dispersion modelling shall be the aggregate maximum half-hour average emission rates from all sources of that contaminant occurring during the maximum emission scenario. Each and every source at the facility shall be considered regardless of when a source was installed or whether or not approval under Section 9 of the *Environmental Protection Act* was obtained for that source

In the Appendix to Regulation 346 there is a mathematical description of three dispersion model calculations, two of those models, the Virtual Source and the Point source have been translated into a software program known as the Regulation 346 Dispersion Modelling Package which is made available by the Ministry of the Environment. This software package has been setup to search through the range of meteorological conditions specified in the regulation to identify the meteorological condition which will give the highest half-hour average concentration at a Point of Impingement. The program is designed to search through all ground-level receptors off the facility's property to find the maximum half- hour average concentration. In addition the Regulation 346 Package can calculate the concentration at specific Points of Impingement, such as air intakes on the roofs of nearby buildings or impingement on the sides or roof of an apartment building.

For most industrial operations, compliance with the point of impingement at which the maximum half-hour concentration will occur will be on or beyond the property line. In the rare circumstance where a company's operation is a separate business within a common industrial enterprise made up of more than one company the property line between the businesses does not have to define the point of impingement. For these circumstance the point of impingement can be defined by the external property line around the common industrial enterprise as long as the aggregate emissions from all companies inside the external property lines are considered together. There are also some circumstances where the concentration needs to be assessed inside the property line, there is a third dispersion model described in the Appendix to Regulation 346 which addresses this circumstance (see Self Contamination).

For the typical circumstance where the POI is located beyond a company's property-line the sources will be modelled as either Virtual Sources or Point sources. The difference between whether a source can be considered a Pointo r Virtual Source is determined by whether or not the release of the pollutant is mixed into the region beside a building due to the strong turbulent air currents near the building.

The key concept in deciding between a Point and Virtual Source is the Maximum Building height. For the situation where the facility is a large rectangular structure the maximum building height will be the height of the highest point on that building excluding stacks, masts or small structures like elevator penthouses. The following rules distinguish a Point from a Virtual Source:

- A source can be considered a point source if the stack height above ground is more than twice the maximum building height (for buildings less than 20 metres high) otherwise the source is a Virtual source;

- For a building greater than 20 metres high, the source is treated as a Point Source if the stack height is more than 20 metres above the roof height otherwise the source is a Virtual Source;

- An additional criterion occurs when a nearby tall building is upwind of the emission source. If a building higher than the height of the stack above the ground is within 100 m of the stack then when the wind blows from the tall building toward the emission source, the source is treated as a virtual source due to the tall building.

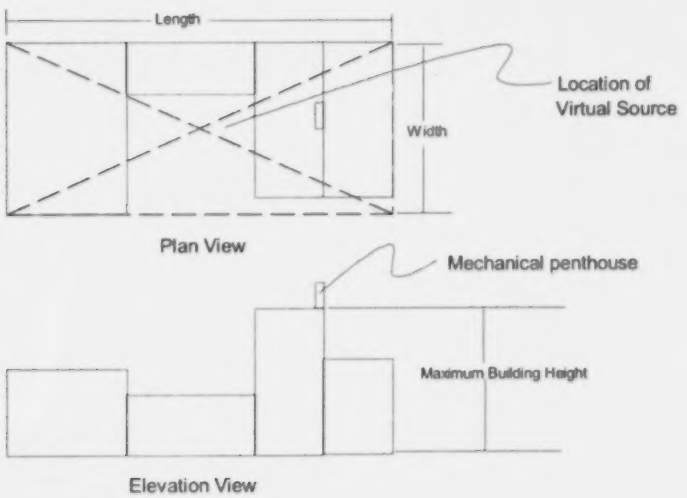
5.1. Virtual Source

For a Virtual Source the emissions are assumed to be mixed into the turbulent region beside the building. An initial horizontal and vertical mixing which depends on the height and the width of the building is then used in the calculations. For Virtual sources the maximum concentration will occur along the property-line. The parameters used in a Virtual Source calculation are: the contaminant emission rate, the maximum building height width and length of the virtual source, the location of the geometric centre of the virtual source, and the location of the property line.

For the Regulation 346 Dispersion Modelling Package the terms length and width have very specific meanings, length is the building dimension in the x- direction or left-to-right direction when the plan view of the building is observed as a Cartesian coordinate system; while the width is the dimension in the y-direction or up-and-down direction, and the location of the virtual source is the centre of the building when observed in the plan view.

For situations where the plant is a series of different buildings the dispersion calculation can encompass all those structures as one Virtual Source provided they are all connected or within 5 metres of each other. For these complicated virtual sources it is helpful to superimpose the rectangular shape of the virtual source on a copy of the plan view of the facility. The dimensions of the virtual source will be those of the smallest rectangle that can be constructed to encompass the contiguous structure. For this virtual source the length is the dimension of the constructed rectangle in the x- direction or left-to-right direction when the plan view of the building is observed as a Cartesian coordinate system; while the width is the dimension in the y-direction or up-and-down direction; the maximum building height will be the height of the highest point on any of the structures that make up the overall Virtual Source excluding stacks, masts or small structures like elevator penthouses; and the location of the virtual source is the centre of the constructed rectangle building when observed in the plan view.

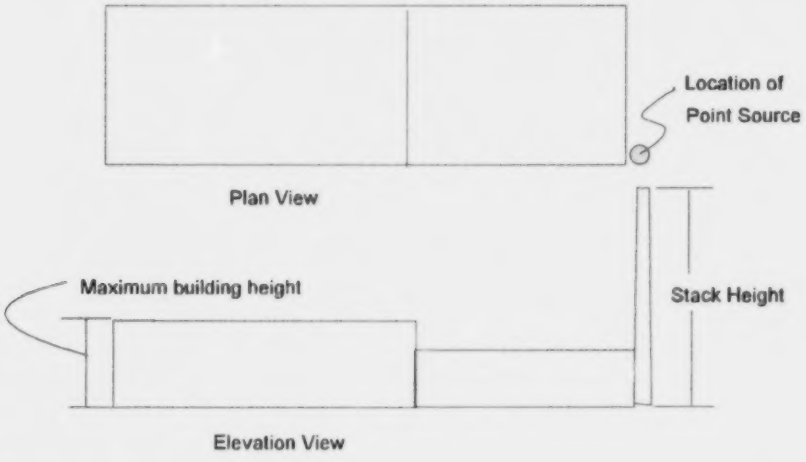
Example: Virtual Source



5.2. Point Source

If the discharge takes place outside of the turbulent air currents near the building the emission would travel downwind as an elevated plume and then mix down to ground level some distance away. This elevated plume emission is known as a Point Source. For Point sources the emissions released from the stack top will travel downwind as an elevated plume. The material would be slowly mixed horizontally and vertically. At some distance from the stack, the material would be mixed down to ground level resulting in the ground-level concentration maximum occurring a distance from the stack. Because emissions from a point source would have to be mixed horizontally and vertically over a significant volume before the plume is mixed to ground level, a given emission rate usually results in a smaller maximum ground-level concentration if it is released from a point source as opposed to a virtual source. The maximum concentration typically occurs at some distance away from the source usually also some distance away from the property-line. The important parameters used in a point source are: the contaminant emission rate, the discharge velocity, the discharge temperature, the stack diameter, the stack height and the stack location, the location of the property line and the location of any off site receptors that the plume may impact on. The emission source is treated as a point source if the stack is higher than the criteria described above. In this case:

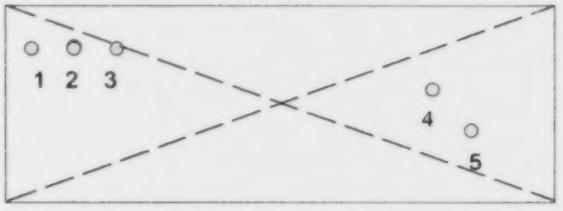
Example: Point Source



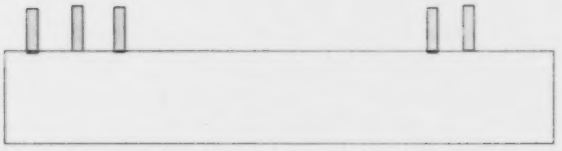
5.3. Single Dispersion Sources

In the common circumstance where all emissions from a facility are emitted as a single virtual source, there is a very useful shortcut that can be employed. Since for a virtual source the emissions discharged from a building are released into the turbulent zone around the building all the discharges can be can be lumped together and considered to be emitted from the common virtual source.

Example: Single Virtual Source Scenario



Plan View



Elevation View

For this source configuration the emissions from Sources 1,2,3,4 & 5 can be lumped together to be emitted from the one virtual source.

If these are the only sources then the dispersion calculation can be further simplified by running the virtual source once for a unit emission rate of 1/g/s. The resultant POI concentration at the property line can be used as a dispersion factor where the product of the dispersion factor and a contaminant emission rate is the POI concentration of that contaminant at the property line.

5.4. Complex Modelling Scenarios

While many industrial facilities can be described as a single virtual source there are many situations where a contaminant is emitted by more than one virtual or point sources or a combination of many virtual and point sources. For these situations the same rules apply as discussed through this procedure, however the exercise is more complicated.

When there is more than one distinct virtual or point source that is emitting the contaminant the dispersion modelling exercise must be carried out for all the sources together and repeated for each individual contaminant. The Regulation 346 Dispersion Modelling Package has a source database feature which can be used to create a separate data file for each contaminant that can tabulate all the individual Point and Virtual Sources of that contaminant. See Case Study III in Appendix E of this document for an example of a complex modelling scenario.

5.5. Self Contamination

For most industrial operations, compliance with the point of impingement at which the maximum half-hour concentration will occur will be on or beyond the property line. There are however some circumstances where the concentration needs to be assessed inside the property line (self contamination). The Regulation 346 model includes a very simplified calculation to estimate possible impacts of emission releases on air intakes, open doors or windows on the source's own building. This circumstance often occurs when the source is in an industrial mall, where the impact of contaminants released by tenants at one unit is assessed in terms of their impact on other neighbouring tenants in the building.

The self contamination formula used in Regulation 346 is called the Scorer-Barrett equation. Concentrations depend on the stretched string distance from the release point of the emission source to the receptor (i.e., an air intake, a doorway or an operable window). The stretched string distance is the shortest distance from the release point to the receptor without intercepting the building.

Concentration ($\mu g/m^3$) = 0.6×10^6 x Emission Rate (g/s)/L^2

where L = 1.57 times the stretched string distance in metres(if the receptor is lower than the emission point)

otherwise

L = the stretched string distance.

5.6. Regulation 346 Dispersion Modelling Package

Although there are ten programs included in the software package, only the first four programs are needed to assess compliance with the half hour average POI concentration limits. Briefly, the purposes of those four programs in the Regulation 346 Dispersion Modelling Package are:

Source Data Manager	Used to input information on the facility's property line coordinates and on the emission source characteristics.
Point of Impingement Manager	Used to input information on the location of nearby buildings.
Maximum Ground Level Concentration	This program uses the files produced in the Source Data Manager and calculates the maximum half hour Point of Impingement concentration outside of the facility's property.
Concentrations at Points:	This program uses information from both data manager programs, (1) and (2), and calculates the maximum concentration at each receptor given in the Point of Impingement Manager.

Table 5

Appendix B provides a brief description of all the programs in the Regulation 346 dispersion modelling package. Case Studies I and II (Appendixes C, D and E) provide examples of dispersion modelling for Virtual Sources, Point sources and complex sources. The application of each of the four programs listed above is illustrated in these case studies.

5.7. Documentation Required for Dispersion Calculations

The information required to perform dispersion modelling is described in Section 2., Facility Description and Section 3.2, Source Data of this Procedure. This information is needed to determine which programs need to be run in the Regulation 346 Dispersion Modelling Package, and to provide all the input data required by the programs. Three case studies describing the development of an emission summary and the application of the Regulation 346 model are attached to this Procedure as Appendices C, D and E. **The dispersion modelling output must be included, an Emission Summary and Dispersion Modelling Report that does not include a copy of the output from each modelling exercise copy of the output from each modelling exercise may not be accepted.**

6. EMISSION SUMMARY TABLE

The report shall contain the following information on the Emission Summary Table, for each contaminant emitted:

- contaminant name;
- CAS number;
- total emission rate for each contaminant, which is the aggregate emission of that contaminant from all sources, in grams per second (g/s);
- aggregate maximum Point of Impingement concentration, in micrograms per cubic metre (ug/m^3);
- Half-hour Point of Impingement Limit, in micrograms per cubic metre (ug/m^3);
- Percentage of Criteria, which is the percentage ratio of the aggregate maximum Point of Impingement concentration to the half-hour Point of Impingement criteria.

The following Table 6 is included as an example to illustrate the format. It is not a requirement to use an exact copy of the sample table.

Emission Summary Table

Contaminant	CAS	Emission Rate	POI Concentration	MOEE Criteria	Percentage of Criteria
		(g/s)	(ug/m^3)	(ug/m^3)	

Table 6

6.1. Point of Impingement Concentration

The POI concentration is the result of combining the emission summary data with dispersion modelling. For a single virtual or point source dispersion calculation the half hour POI concentration of a contaminant will be the product of the dispersion concentration predicted for an emission rate of 1 g/s and the overall emission rate of that contaminant.

Example: POI Concentration Calculation

> A facility is configured as a Virtual Source. The resultant maximum half-hour point of impingement concentration predicted is 500 ug/m^3 for an inputted emission rate of 1 g/s. The facility emits 2 g/s of xylene, therefore the maximum half hour point of impingement concentration for xylene will be 1000 ug/m^3

For a complex facility where common contaminants are emitted from a variety of sources, point and virtual, the dispersion modelling will have to be done separately for each contaminant.

6.2. Percentage of Criteria

This figure is the percentage ratio of the predicted Point of Impingement concentration to the half-hour Point of Impingement criteria.

Example: Percentage of Criteria

> A baghouse serves a wood shaping operation and has an emission rate of 0.0378 mg/s of which when combined with the dispersion modelling results in a point of impingement concentration of 14 ug/m^3. The appropriate criterion for wood dust is 100 ug/m^3 (suspended particulate matter. Thus, the Percentage of Criteria is 14%.

The individual responsible for preparing the emission summary must be able to defend the accuracy of the data presented in the Source Summary Table and an Emission Summary Table. **An emission estimate for which the Data Quality is poor and for which the Percentage of the Criteria is also high does not make a good argument for compliance.**

Appendix A

SUMMARY of POINT OF IMPINGEMENT STANDARDS, AMBIENT AIR QUALITY CRITERIA (AAQCs), and APPROVALS SCREENING LEVELS (ASLs)

STANDARDS DEVELOPMENT BRANCH
ONTARIO MINISTRY OF THE ENVIRONMENT

June 1994
(Revised August 1998)

Note to Users:

The attached tables provide a listing of air quality standards and guidelines currently used in Ontario. Since the list was last updated in 1994, the Ministry of the Environment has published its *Three Year Plan for Standard Setting* (http://www.ene.gov.on.ca/envision/standards/index.htm) which places a priority on updating and revising air standards in the province, identifying some 70 contaminants scheduled to be reviewed over the next several years. In March 1998, the Ministry posted proposals for the first nine air standards to be developed under the Plan (on the Environmental Bill of Rights Registry). The nine contaminants are: acetaldehyde, carbon tetrachloride, 1,4-dichlorobenzene, ethylene dichloride, formaldehyde, methylene chloride, styrene, tetrachloroethylene, and trichloroethylene. Information on the proposed changes to air standards for these substances can be obtained by clicking on the name of the substance which will open the respective registry file which appears on the Environmental Bill of Rights Electronic Registry. Alternatively, additional information can be obtained by contacting Dr. Stuart Bailey of the Ministry's Standards Development Branch at (416) 327-4460.

Once stakeholder comments on the proposals have been assessed, the Ministry will revise the individual standards and update this listing as appropriate The Ministry will also take that opportunity to make other changes to this listing which will be aimed at simplifying and rationalizing terminology such as "standard", "interim standard" and "approval screening level".

One other change to note from the 1994 version of this listing is that the point of impingement standard and ambient air quality criteria for inorganic lead have been revised reflecting recommendations of the former Advisory Committee on Environmental Standards adopted in December of 1994.

Contaminant Name	Contaminant Code or CAS No.	Point of Impingement Standard			Ambient Air Quality Criteria (AAQC)				
		Half Hour Point of Impingement Limit ($\mu g/m^3$)	Point of Impingement Limiting Effect	Status	Annual ($\mu g/m^3$)	24 Hour ($\mu g/m^3$)	1 Hour ($\mu g/m^3$)	10 Minute ($\mu g/m^3$)	AAQC Limiting Effect
Acetic acid	64-19-7	2500	Odour	S		2500			Odour
Acetone	67-64-1	48000	Odour	S		48000			Odour
Acetophenone	98-86-2	625	Odour	IS			1167	850	Health and Odour
Acetylene	74-86-2	56000	Odour	S		56000			Odour
Acrolein	107-02-8	28	Health	IS		23.5			Health
Acrylamide	79-06-1	45	Health	S		15			Health
Acrylonitrile	107-13-1	300	Health	IS		100			Health
Adipic acid	124-04-9	3500	Health	ASL		1167			Health
Alkyltoluene sulphonamide, n-	N/A	100	-	IS		120			Particulate
Allyl glycidyl ether	106-92-3	180	Health	ASL		60			Health
Aluminum distearate	300-92-5	100	Health	ASL		2180			Particulate
Aluminum oxide	1344-28-1	100		IS		120			Particulate
Aluminum stearate	7047-84-9	100	Health	ASL		2180			Particulate
Aluminum tristearate	637-12-7	100	Health	ASL		2180			Particulate
Ammonia	7664-41-7	3600	Odour	S		3600			Odour
Ammonium Chloride	12125-02-9	100		IS		120			Particulate
Amyl acetate, iso-	128-92-8					53200			Health and Odour
Amyl actetate, n-	628-63-7					53200			Health and Odour
Amyl acetate, secondary	626-38-0					66500			Health and Odour
Antimony and compounds	7440-36-0	75	Health	S		25			Health
Arsenic and compounds	7440-38-2	1	Health	IS		0.3			(A) Health
Arsine	7784-42-1	10	Health	S		5			Health
Asbestos (fibres > 5 µm in length)	1332-21-4					0.04 fibres/cm^3			Health
Asbestos (total)	1332-21-4	5	Health	IS					
Barium - total water soluble	7440-39-3	30	Health	IS		10			Health
Benzene	71-43-2			CARC					Health
Benzo(a)pyrene - single source	50-32-8	0.0033	Health	IS	0.00022	0.0011			Health
Benzo(a)pyrene, all sources	50-32-8				0.0003				Health
Benzoic acid	68-85-0	2100	Health	ASL		700			Health
Benzothiazole	95-16-9	200	Health	IS		70			Health
Benzoyl chloride	98-88-4	350	Health	IS		125			Corrosion and Health
Benzyl alcohol	100-51-6	2640	Health	ASL		880			Health
Beryllium and compounds	7440-41-7	0.03	Health	S		0.01			Health
Biphenyl	92-52-4	60	Odour	IS			60		Odour
Borax	1303-96-4	100	Health	IS		33			Health
Boric acid	10043-35-3	100	Health	IS		33			Health
Boron	7440-42-8	100		S		120			Particulate
Boron tribromide	10294-33-4	100	Corrosion	S		35			Corrosion
Boron trichloride	10294-34-5	100	Corrosion	S		35			Corrosion
Boron trifluoride	7637-07-2	5		S		2			Vegetation
Bromacil	314-40-9	30	Health	IS		10			Health
Bromine	7726-95-6	70	Health	S		20			Health
Bromochlorodifluoromethane (Halon 1211)	N/A	see	"Part VI/EPA"						Ozone depleting
Bromoform	75-25-2	165	Health	ASL		55			Health
Bromotrifluoromethane (Halon 1301)	75-63-8	see	"Part VI/EPA"						Ozone depleting

Contaminant Name	Contaminant Code or CAS No.	Point of Impingement Standard			Ambient Air Quality Criteria (AAQC)				
		Half Hour Point of Impingement Limit (µg/m³)	Point of Impingement Limiting Effect	Status	Annual (µg/m³)	24 Hour (µg/m³)	1 Hour (µg/m³)	10 Minute (µg/m³)	AAQC Limiting Effect
Butanol, iso-	78-83-1	1940	Odour	IS		655	15000	2640	Odour; Health; Odour
Butanol, n-	71-36-3	2278	Odour	IS		770	15000	3100	Odour; Irr; Odour
Butanol, tertiary	75-65-0			UD		30300			Health
Butoxy-2-propanol, 1-	5131-66-8	9900	Health	ASL		3300			Health
Butyl acetate, n-	123-86-4	735	Odour	IS		248	15000	1000	Odour; Health; Odour
Butyl acrylate	141-32-2	100		IS		120			Particulate
Butyl benzene sulphonamide, n-	3622-84-2	105	Health	ASL		35			Health
Butyl benzene phthalate	85-68-7	450	Health	ASL		150			Health
Butyl stearate	123-95-5	100		IS		120			Particulate
Cadmium and compounds	7440-43-9	5	Health	S		2			(A) Health
Calcium carbide	75-20-7	20	Corrosion	IS		10			Corrosion
Calcium cyanide (as total salt)	592-01-8	100		IS		120			Particulate
Calcium hydroxide	1305-62-0	27	Corrosion	S		13.5			Corrosion
Calcium oxide	1305-78-8	20	Corrosion	S		10			Corrosion
Calcium stearate	1592-23-0	100	Health	ASL		35.0			Particulate
Captan	133-06-2	75	Health	IS		25			Health
Carbon black	1333-86-4	25	Soiling	S		10			Soiling
Carbon disulphide	75-15-0	330	Odour	S		330			Odour
Carbon monoxide	630-08-0	6000	Health	S		15700 (8 hour average)	36200		(A) see note below
Carbon tetrachloride	56-23-5	1800	Health	IS		600			Health
Chloramben	133-90-4	100		IS		120			Particulate
Chlordane	57-74-9	15	Health	IS		5			Health
Chlorinated dibenzo-p-dioxins (CDDs) (See D/F)	N/A	15 pgTEQ/m³	Health			5 pgTEQ/m³			Health
Chlorine	7782-50-5	300	Health	S		150			Health and Vegetation
Chlorine dioxide	10049-04-4	85	Health	S		30			Health
Chlorodifluoromethane (Freon 22)	75-45-6	1050000	Health	IS		350000			Health
Chloroform	67-66-3	1500	Health	IS		500			Health
Chloropentafluoroethane (CFC-115)	76-15-3	see	"Part VI/EPA"						Ozone depleting
Chromium -di-, tri- and hexavalent forms	7440-47-3	5	Health	IS		1.5			Health
Citric acid	77-92-9	100	Particulate	IS		120	300		Health and Particulate
Coal tar pitch volatiles - soluble fraction	8007-45-2	3	Health	IS	0.2	1			Health
Cobalt	7440-48-4	0.3	Health	IS		0.1			Health
Copper	7440-50-8	100	Health	S		50			Health
Cresols	1319-77-3	230	Health	S		75			Health
Cyanogen chloride	506-77-4	15	Health	IS		12			Health
Cyclohexane	110-82-7	300000	Health	IS		100000			Health
Dalapon sodium salt	127-20-8	100	Health	IS		50			Health
Decarborane	17702-41-9	50	Health	S		25			Health
Decane, n	124-18-5			UD			60000		Health and Odour
Decene, 1-	872-05-9	180000	Health	IS		60000			Health
Detergent enzyme (Subtilisin)	1395-21-7	0.2	Health	IS		0.06			Health

Contaminant Name	Contaminant Code or CAS No.	Point of Impingement Standard			Ambient Air Quality Criteria (AAQC)				
		Half Hour Point of Impingement Limit ($\mu g/m^3$)	Point of Impingement Limiting Effect	Status	Annual ($\mu g/m^3$)	24 Hour ($\mu g/m^3$)	1 Hour ($\mu g/m^3$)	10 Minute ($\mu g/m^3$)	AAQC Limiting Effect
Diacetone alcohol	123-42-2	990	Odour	IS		335		1350	Odour
Diazinon	333-41-5	9	Health	IS		3			Health
Diborane	19287-45-7	20	Health	S		10			Health
Dibromotetrafluoroethane (Halon 2402)	124-73-2	see	"Part VI/EPA"						Ozone depleting
Dibutyl amine	111-92-2			UD			2645		Health and Odour
Dibutyl phthalate (DBP)	84-74-2	100	Health	IS		50			Health
Dibutyltin dilaurate	77-58-7	100	Health	IS		30			Health
Dicapryl phthalate	131-15-7	100		S		120			Particulate
Dichloro-1,1,2,2, - tetrafluoroethane, 1,2, (Freon 114)	76-14-2	2100000	Health	IS		700000	see	"Part VI/EPA"	Health
Dichlorobenzene, ortho-	95-50-1	37000	Health	IS			30500		Health
Dichlorobenzidene, 3,3-	91-94-1			CARC					Health
Dichloroethane, 1,1-	75-34-3	600	Health	ASL		200			Health
Dichloroethylene, cis-1,2-	156-59-2	315	Health	ASL		105			Health
Dichloroethylene, sym-1,2-	540-59-0	315	Health	ASL		105			Health
Dichloroethylene, trans-1,2-	156-60-5	315	Health	ASL		105			Health
Diethyl amine	109-89-7			UD			2910		Health and Odour
Diethyl phthalate (DEP)	84-66-2	100	Health	IS		125			Health
Diethylene glycol monobutyl ether	112-34-5					65			Health
Diethylene glycol monobutyl ether actetate	124-17-4					85			Health
Diethylene glycol monoethyl ether	111-90-0	800	Odour	IS		273		1100	Odour
Diethylene glycol monoethyl ether acetate	112-12-5					1800			Health
Diethylene glycol monomethyl ether	111-77-3	800	Odour	ASL		1200			Health
Diethylhexyl phthalate (DEHP)	117-81-7	100	Health	IS		50			Health
Difluorodichloromethane (Freon 12)	75-71-8	1500000	Health	IS		500000	see	"Part VI/EPA"	Health
Dihexyl phthlalate (DHP)	84-75-3	100	Health	IS		50			Health
Diisobutyl ketone	108-83-8	470	Odour	IS		3500		649	Health; Odour
Dimethyl acetamide, n,n-	127-19-5	900	Health	IS		300			Health
Dimethyl amine	124-40-3			UD			1840		Health and Odour
Dimethyl disulphide	624-92-0	40	Odour	S			40		Odour
Dimethyl ether	115-10-6	2100	Odour	IS		2100			Odour
Dimethyl methylphosphonate	756-79-6					875			Health
Dimethyl phthalate (DMP)	131-11-3	100	Health	IS		125			Health
Dimethyl sulfoxide	67-68-5	6300	Health	ASL		2100			Health
Dimethyl sulphide	75-18-3	30	Odour	S			30		Odour
Dimethyl-1,3-diamino propane, n,n-	109-55-7	60	Health	IS		20			Health
Dioctyl phthalate	117-84-0	100	Health	S		120			Particulate
Dioxane	123-91-1			UD		3500			Health
Dioxolane-1,3	236098	30	Health	IS		10			Health
Diphenylamine	122-39-4	50	Health	IS		17.5			Health
Diquat dibromide -respirable	85-00-7	0.096	Health	IS		0.032			Health
Diquat dibromide -total in ambient air	85-00-7	0.48	Health	IS		0.16			Health
Dodecyl benzene sulphonic acid	1886-81-3	100		IS		120			Particulate
Dodine	24391-00-3	30	Health	IS		10			Health
Droperidol	548-73-2	3	Health	IS		1			Health
Dustfall	N/A	8000 ($\mu g/m^2$)	Soiling	S	4.6 g/m^2 + (annual)	7g/m^2 (30 day)			(A) Soiling
Ethanol (Ethyl alcohol)	64-17-5	19000	Odour	IS			19000		Odour

Contaminant Name	Contaminant Code or CAS No.	Point of Impingement Standard			Ambient Air Quality Criteria (AAQC)				
		Half Hour Point of Impingement Limit (µg/m³)	Point of Impingement Limiting Effect	Status	Annual (µg/m³)	24 Hour (µg/m³)	1 Hour (µg/m³)	10 Minute (µg/m³)	AAQC Limiting Effect
Ethyl acetate	141-78-6	19000	Odour	S			19000		Odour
Ethyl acrylate	140-88-5	4.5	Odour	S			4.5		Odour
Ethyl benzene	100-41-4	4000	Odour	S			4000		Odour
Ethyl ether	60-29-7	30000	Health	IS		30000			Health and Odour
Ethyl hexanol, 2-	104-76-7	600	Odour	IS			600		Odour
Ethyl-3-ethoxy proprionate	763-69-9	147	Odour	IS		50		200	Odour
Ethylanthraquinone, 2-	84-51-5	30	Health	IS		10			Health
Ethylene	74-85-1			UD		40			Vegetation
Ethylene dibromide	106-93-4	9	Health	ASL		3			Health
Ethylene dichloride	107-06-2	1200	Health	IS		400			Health
Ethylene glycol	107-21-1					12700			Health
Ethylene glycol butyl ether (Butyl cellosolve)	111-76-2	350	Odour	IS		2400		500	Health;Odour
Ethylene glycol butyl ether acetate (But.cell.ace)	112-07-2	500	Odour	IS		3250		700	Health;Odour
Ethylene glycol dinitrate	628-96-6	10	Health	IS		3			Health
Ethylene glycol ethyl ether (Cellosolve)	110-80-5	800	Odour	IS		380		1100	Health;Odour
Ethylene glycol ethyl ether acetate (Cell.ace.)	111-15-9	220	Odour	IS		540		300	Health;Odour
Ethylene glycol monhexyl ether	112-25-4					2500			Health
Ethylene oxide	75-21-8	15	Health	IS		5			Health
Ethylenediaminetetra acetic acid	0	100		IS		120			Particulate
Fentanyl citrate	990-73-8	0.06	Health	IS		0.02			Health
Ferric oxide	1309-37-1	75	Soiling	S		25			Soiling
Fluoridation -as total fluorides, total GS	7664-39-3					40 µg/100 cm² /30 day			(A) Vegetation
Fluoridation -as total fluorides, total NGS	7664-39-3					80 µg/100 cm² /30 day			(A) Vegetation
Fluorides (as HF) - gaseous -growing season GS	7664-39-3	4.3	Vegetation	S		0.34 µg/m³ /30 day			(A) Vegetation
Fluorides (as HF) - total, growing season GS	7664-39-3	8.6	Vegetation	S		0.86			(A) Vegetation
Fluorides (as HF) - total, growing season GS	7664-39-3					1.72			(A) Vegetation
Fluorides (as HF)- total, non growing season NGS	7664-39-3	17.2	Vegetation	S		0.69/µg/m³/30 day			(A) Vegetation
Fluorides (as HF)- total non-growing season NGS	7664-39-3					3.44			(A) Vegetation
Fluorides in dry forage-dry weight	7664-39-3					1.38 µg/m³/30day			(A) Vegetation
						35 ppm/30 day ave.*			(A) Effects on animals
						60 ppm/30day ave.**			(A) Effects on animals
						60 ppm/60day ave.***			(A) Effects on animals
Fluorinert 3M-FC-70	N/A	100		IS		120			Particulate
Formaldehyde	50-00-0	65	Odour	S			65		Odour
Formic acid	64-18-6	1500	Health	S		500			Health
Furfural	98-01-1	1000	Odour	S			1000		Odour
Furfuryl alcohol	98-00-0	3000	Health	S		1000			Health
Gasoline	8006-61-9			UD					Odour
Glutaraldehyde	111-30-8	42	Health	IS		14	35		Health
Haloperidol	52-86-8	0.3	Health	IS		0.1			Health

Contaminant Name	Contaminant Code or CAS No.	Point of Impingement Standard			Ambient Air Quality Criteria (AAQC)				
		Half Hour Point of Impingement Limit (µg/m³)	Point of Impingement Limiting Effect	Status	Annual (µg/m³)	24 Hour (µg/m³)	1 Hour (µg/m³)	10 Minute (µg/m³)	AAQC Limiting Effect
Hexachlorocyclopentadiene	77-47-4	6	Health	IS		2			Health
Hexamethyl disilazane	999-97-3	5	Health	IS		2			Health
Hexamethylene diisocyanate monomer	822-06-0	1.5	Health	IS		0.5			Health
Hexamethylene diisocyanate trimer	4035-89-6	3	Health	IS		1			Health
Hexamethylenediamine	124-09-4	48.0	Health	ASL		16.0			Health
Hexamethyleneimine	111-49-9	945	Health	ASL		315			Health
Hexane	110-54-3	35000	Health	IS		12000			Health
Hexylene glycol	107-41-5	14400	Health	IS			12000		Health and Irrit.
Hydrogen bromide	10035-10-6	800	Health	IS			668		Health
Hydrogen chloride	7647-01-0	100	Corrosion	S		40			Corrosion
Hydrogen cyanide	74-90-8	1150	Health	S		575			Health
Hydrogen peroxide	7722-84-1	90	Health	IS		30			Health
Hydrogen sulphide	7783-06-4	30	Odour	S			30		(A) Odour
Iron - metallic	15438-31-0	10	Soiling	S		4			Soiling
Isobutyl acetate	110-19-0	1220	Odour	IS		412		1660	Odour; Odour
Isopropyl ether	108-20-3	220	Odour	ASL		110000			Health
Isopropyl acetate	108-21-4	1470	Odour	IS		500		2000	Odour; Odour
Isopropyl benzene	98-82-8	100	Odour	IS			100		Odour
Lead	7439-92-1	6	Health	S		0.7 µg/m³/30 day +			(A) Health
Lead - single sample	7439-92-1					2			(A) Health
Lead - in dusfall	7439-92-1					0.1 g/m²/30 day			Health
Lindane (Hexachlorocyclohexane)	58-89-9	15	Health	IS		5			Health
Lithium -other than hydrides	7439-93-2	60	Health	S		20			Health
Lithium hydrides	7580-67-8	7.5	Health	S		2.5			Health
Magnesium oxide	1309-48-4	100		S		120			Particulate
Magnesium stearate	557-04-0	100	Health	ASL		35.0			Particulate
Malathion	121-75-5	100		IS		120			Particulate
Maleic anhydride	108-31-6	100	Health	IS		30			Health
Manganese compounds (including permanganates)	7439-96-5	7.5	Health	IS		2.5			Health
Mercaptans (as Methyl mercaptan) -total	74-93-1	20	Odour	S			20		(A) Odour
Mercaptobenzothiazole disulphide	120-78-5	100		IS		120			Particulate
Mercury	7439-97-6	5	Health	S		2			(A) Health
Mercury (as Hg) - alkyl compounds	7439-97-6	1.5	Health	S		0.5			Health
Metaldehyde (Acetaldehyde tetramer)	108-62-3	100		IS		120			Particulate
Methacrylic acid	79-41-4	2000	Odour	IS		2000			Odour
Methane diphenyl diisocyanate (MDI)	101-68-8	3	Health	IS		1			Health
Methanol (Methyl alcohol, Wood alcohol)	67-56-1	84000	Health	S		28000			Health
Methoxy-1-propyl acetate,2-	70657-70-4	4600	Health	ASL		1530			Health
Methoxychlor	72-43-5	100		IS		120			Particulate
Methyl acrylate	96-33-3	4	Odour	S			4		Odour
Methyl bromide	74-83-9	4000	Health	IS		1350			Health
Methyl chloride	74-87-3	20000	Health	IS		7000			Health
Methyl ethyl ketone (2-Butanone)	78-93-3	31000	Odour	S			31000		Odour
Methyl ethyl ketone peroxide	1338-23-4	250	Health	IS		80	200		Health;Health
Methyl isobutyl ketone	108-10-1	1200	Odour	IS		1200			Odour

Contaminant Name	Contaminant Code or CAS No.	Point of Impingement Standard			Ambient Air Quality Criteria (AAQC)				
		Half Hour Point of Impingement Limit (µg/m³)	Point of Impingement Limiting Effect	Status	Annual (µg/m³)	24 Hour (µg/m³)	1 Hour (µg/m³)	10 Minute (µg/m³)	AAQC Limiting Effect
Methyl mercapto aniline	2987-53-3			UD					Odour
Methyl methacrylate	80-62-6	860	Odour	S		860			Odour
Methyl salicylate	119-36-8	300	Health	IS		100			Health
Methyl styrene, alpha	98-83-9			UD			24000		Health
Methyl tert-butyl ether	1634-04-4	2200	Odour	ASL		7000			Health
Methyl-2-hexanone, 5-	110-12-3	460	Odour	IS		160		630	Odour
Methyl-2-pyrrolidone, n-	872-50-4						40000		Health
Methyl-n-amyl ketone	110-43-0			UD		4600			Health
Methylal	109-87-5	18000	Health	IS		6200			Health
Methylcyclopentadienyl manganese tricarbonyl (MMT)	12108-13-3	30	Health	IS		10			Health
Methylene chloride	75-09-2	5300	Health	IS		1765			Health
Methylene dianiline	101-77-9	30	Health	IS		10			Health
Methylene iodide	75-11-6	195	Health	ASL		65			Health
Methylene-bis-2-chloroaniline, 4,4-	101-14-4	30	Health	IS		10			Health
Miconazole nitrate	22832-87-7	15	Health	IS		5			Health
Milk powder	N/A	20	Soiling	S		20			Soiling and Odour
Mineral Spirits	N/A	30000	Odour	IS		10000			Health
Molybdenum	7439-98-7	100		IS		120			Particulate
Monochlorobenzene	108-90-7	4200	Health	IS			3500	4500	Health; Odour
Monomethyl amine	74-89-5	25	Odour	S		25			Odour
Napthalene	91-20-3	36	Odour	IS		22.5		50	Health, Odour
Naphthol, apha-	90-15-3	100	Health	IS		100			Health
Nickel	7440-02-0	5	Vegetation	S		2			(A) Vegetation
Nickel carbonyl	13463-39-3	1.5	Health	S		0.5			Health
Nitric acid	7697-37-2	100	Corrosion	S		35			Corrosion
Nitrilotriacetic acid	139-13-9	100		S		120			Particulate
Nitrogen oxides (see NOx)	10102-44-0	500	Health	S		200	400		(A) Health; Health
Nitrogylcerin	55-63-0	10	Health	IS		3			Health
Nitrosodiethylamine, n-	55-18-5			CARC					Health
Nitrosodimethylamine, n-	62-75-9			CARC					Health
Nitrous oxide	10024-97-2	27000	Health	IS		9000			Health
Octane	111-65-9	45400	Odour	IS		15300		61800	Odour,Odour
Octene, 1-	25377-83-7	150000	Health	IS		50000			Health
Oleic acid	112-80-1	6	Health	IS			5		Health
Oxalic acid	144-62-7	75	Health	IS		25			Health
Oxo-heptyl acetate	90438-97-2	255	Health	ASL		85			Health
Oxo-hexyl acetate	88230-35-7	255	Health	ASL		85			Health
Ozone	10028-15-6	200	Health	S			165		(A) Health and Vegetation
Palladium - water soluble compounds	2102974	30	Health	IS		10			Health
Paraquat dichloride - respirable	1910-42-5	0.009	Health	IS		0.003			Health
Paraquat dichloride - total in ambient air	1910-42-5	0.045	Health	IS		0.015			Health
Penicillin	1406-05-9	0.3	Health	IS		0.1			Health
Pentaborane	19624-22-7	3	Health	S		1			Health
Pentachlorophenol	87-86-5	60	Health	IS		20			Health
Perchloroethylene	127-18-4	10000	Health	IS		4000			Health
Phenol	108-95-2	100	Health	S		100			Health

Contaminant Name	Contaminant Code or CAS No.	Point of Impingement Standard			Ambient Air Quality Criteria (AAQC)				
		Half Hour Point of Impingement Limit (µg/m³)	Point of Impingement Limiting Effect	Status	Annual (µg/m³)	24 Hour (µg/m³)	1 Hour (µg/m³)	10 Minute (µg/m³)	AAQC Limiting Effect
Phosgene	75-44-5	130	Health	S		45			Health
Phosphine	7803-51-2	30	Health	IS		10			Health
Phosphoric acid (as P2O5)	7664-38-2	100		S		120			Particulate
Phosphorus oxychloride	10025-87-3	40	Health	IS		12			Health
Phosphorus pentachloride	10026-13-8	30	Health	IS		10			Health
Phthalic anhydride	85-44-9	100		S		120			Particulate
Pimozide	2062-78-4	3	Health	IS		1			Health
Platinum - water soluble compounds	7440-06-4	0.6	Health	IS		0.2			Health
Polybutene -1-sulphone	N/A	100		IS		120			Particulate
Polycholrinated biphenyls (PCBs)	1336-36-3	0.45	Health	IS	0.035	0.15			Health
Polychloroprene	25267-15-6	100		IS		500			Particulate
Potassium cyanide	151-50-8	100		IS		120			Particulate
Potassium hydroxide	1310-58-3	28	Corrosion	IS		14			Corrosion
Potassium nitrate	7757-79-1	100		IS		120			Particulate
Propanol, iso- (Isopropyl alcohol, Isopropanol)	67-63-0	24000	Odour	IS		24000			Odour
Propanol, n- (Propyl alcohol)	71-23-8	48000	Health	IS		16000			Health
Propionaldehyde	123-38-6	7	Odour	IS		2.5		10	Odour; Odour
Propionic acid	79-09-04	100	Odour	IS			100		Odour; Odour
Propionic annhydride (as Proprionic acid)	123-62-6	100	Odour	IS			100		Odour
Propyl acetate, n-	109-60-4	900	Odour	ASL		6600			Health
Propylene dichloride	78-87-5	2400	Odour	S		2400			Odour
Propylene glycol	57-55-6	100	Health	IS		120			Health
Propylene glycol methyl ether	107-98-2	89000	Odour	IS		30000		121000	Odour;Odour
Propylene glycol monomethyl ether acetate	108-65-6	5000	Odour	IS		5000			Odour
Propylene oxide	75-56-9	13500	Health	IS		4500			Health
Pyridine	110-86-1	60	Odour	IS		150		80	Health; Odour
Quinone	106-51-4	45	Health	ASL		15			Health
Selenium	7782-49-2	20	Health	IS		10			Health
Silane	7803-62-5	450	Health	IS		150			Health
Silica -respirable (<10 um diameter), cristabolite	14464-46-1	15	Health	IS		5			Health
Silica -respirable (<10 um diameter), quartz	14808-60-7	15	Health	IS		5			Health
Silica -respirable (<10 um diameter), tridymite	15468-32-3	15	Health	IS		5			Health
Silver	7440-22-4	3	Health	S		1			Health
Sodium bisulphite	7631-90-5	100		IS		120			Particulate
Sodium chlorate	2146050	18	Health	IS		6			Health
Sodium chlorite	7758-19-2	60	Health	IS		20			Health
Sodium cyanide	143-33-9	100		IS		120			Particulate
Sodium hydroxide	1310-73-2	20	Corrosion	IS		10			Corrosion
Sodium nitrate	7631-99-4	100	Particulate	ASL		7000			Health
Stannous Chloride (as Sn)	7772-99-8	30	Health	IS		10			Health
Strontium	7440-24-6	100		IS		120			Particulate
Strontium carbonate	596562	100		IS		120			Particulate
Strontium hydroxide	6055902	100		IS		120			Particulate
Strontium oxide	480232	100		IS		120			Particuate
Styrene	100-42-5	400	Odour	S		400			Odour
Sulpamic acid	5329-14-6	100		IS		120			Particulate

Contaminant Name	Contaminant Code or CAS No.	Point of Impingement Standard			Ambient Air Quality Criteria (AAQC)				
		Half Hour Point of Impingement Limit ($\mu g/m^3$)	Point of Impingement Limiting Effect	Status	Annual ($\mu g/m^3$)	24 Hour ($\mu g/m^3$)	1 Hour ($\mu g/m^3$)	10 Minute ($\mu g/m^3$)	AAQC Limiting Effect
Sulphur dioxide	2025881	830	Health	S	55	275	690		(A) Health & Vegetation
Sulphur hexafluoride	2551-62-4	1800000	Health	IS		600000			Health
Sulphuric acid	7664-93-9	100	Corrosion	S		35			Corrosion
Suspended particulate matter < 44 um aero. Diam.	N/A	100	Visibility	S	60++	120			(A) Visibility
Talc - fibrous	14807-96-6	5	Health	IS		2			Health
Tellurium - excluding hydrogen telluride	13494-80-9	30	Health	S		10			Health
Tetrabutylurea	4559-86-8	30	Health	IS		10			Health
Tetrahydrofuran	109-99-9	93000	Odour	S		93000			Odour
Tetramethyl thiuram disulphide	137-26-8	30	Health	IS		10			Health
Thiourea	62-56-6	60	Health	IS		20			Health
Tin	7440-31-5	30	Health	S		10			Health
Titanium	7440-32-6	100		S		120			Particulate
Titanium dioxide	13463-67-7	100	Health	ASL		34			Health
Tolmetin sodium	35711-34-3	15	Health	IS		5			Health
Toluene	108-88-3	2000	Odour	S		2000			Odour
Toluene diisocyanate	584-84-9	1	Health	S		0.5			Health
Total reduced sulphur (as hydrogen sulphide)	N/A	40	Odour	IS			40		Odour
Tributyltin oxide	56-35-9	0.42	Health	ASL		0.14			Health
Trichlorobenzene, 1,2,4-	120-82-1	100		IS		400			Irr;Health
Trichloroethane, 1,1,1,- (Methyl chloroform)	71-55-6	350000	Health	S		115000			Health
Trichloroethylene	79-01-6	85000	Health	S		28000			Health
Trichlorofluoromethane	75-69-4	18000	Health	IS		6000	see	"Part VI/EPA"	Health
Trifluoroacetic acid	27880	45	Health	ASL		15			Health
Trifluorotrichloroethane	76-13-1	2400000	Health	S		800000	see	"Part VI/EPA"	Health
Trimethyl amine	75-50-3	0.5	Odour	IS			0.5		Odour
Trimethylbenzene, 1,2,4-	95-63-6	500	Odour	IS		1000			Odour & Health
Trimethylol propane	77-99-6	100	Health	IS		1250			Health
Tripropyltin methacrylate	N/A	3	Health	IS		1			Health
Vanadium	7440-62-2	5	Health	IS		2			(A) Health
Vinyl chloride	75-01-4	3	Health	IS	0.2	1			Health
Vinylidene chloride (1,1- Dichloroethane)	75-35-4	70	Health	IS		35			Health
Warfarin	81-81-2	30	Health	IS		10			Health
Whey powder	N/A	100		IS		120			Particulate
Xylenes	1330-20-7	2300	Odour	S		2300			Odour
Zinc	7440-66-6	100		S		120			Particulate
Zinc chloride	7646-85-7	12	Health	IS		10			Health
Zinc stearate	557-05-1	100	Health	ASL		35.0			Particulate

TERMS:
carbon monoxide -8 hour average based on high background levels from automobiles.
* average monthly results for growing season.
** average results for any single month.
*** average of 2 consecutive months.
GS -Growing Season May 1 - September 30- Northern Ontario, Mid-Ontario & N Regions
April 1 - October 31 - Southern Ontario, SW, WC, E & C Regions
NGS -Non Growing Season October 1 - April 30 - Northern Ontario, Mid Ontario & N Regions
November 1 - March 31 - Southern Ontario, SW, WC, E & C Regions.
NOx (Nitrogen Oxides) - AAQCS are based on nitrogen dioxide. Nitrogen oxides are assumed to be the sum of nitrogen dioxide and nitrogen monoxide

+ arithmetic mean ++ geometric mean
S = Air Quality Standard, IS = Interim Standard, ASL Approval's Screening Level
CARC = Carcinogen, UD = Under Development, or odour threshold review.
NEW = A revision to previous limits or recent ASL developed
N/A = Not Available, Irr = Irritant
D/F = dioxins & furans, see notes following Table 1.
A = AAQC Chemicals listed in Regulation 337 (formerly Regulation 296) under the Environmental Protection Act.

NOTES SPECIFIC TO TABLE 1:

7) In Ontario, the enabling legislation for the Point of Impingement Standards is Regulation 346 (formerly Regulation 308) of the *Environmental Protection Act.* Regulation 346 should be consulted for application of the Point of Impingement Standards. Desirable Ambient Air Quality Criteria are defined by Regulation 337 (formerly Regulation 296) under the *Environmental Protection Act.*

8) When the 'Status' column is given as 'CARC' (ie. CARCINOGEN), it is implied that there is no assigned standard or interim standard. Further, emissions to the environment are to be prevented or limited to the greatest extent possible.

9) D/F - The ½-hour Point of Impingement Limit for chlorinated dibenzo-p-dioxins and chlorinated dibenzofurans is an interim guideline.

Calculation of TEQ (Toxicity Equivalent)

International toxicity equivalency factors (I-TEFs) are applied to 17 dioxin and furan isomers of concern to convert them into 2,3,7,8-TCDD (tetrachlorodibenzo-p-dioxin) toxicity equivalents. The conversion involves multiplying the concentration of the isomer by the appropriate I-TEF to yield the TEQ for this isomer. Summing the individual TEQ values for each of the isomers of concern provides the total toxicity equivalent level for the sample mixture.

A table listing the 17 isomers of concern and their I-TEFs can be found in the MOE publication titled: Environment Information - Dioxins & Furans; PIBS 681b, revised 08/91 or in the example provided below.

Example:

Dioxin/Furan Isomers of Concern	International Toxicity Equivalency Factors (I-TEFs)	Concentration pg/m^3 (Analytically measured)	Toxicity Equivalent (TEQ) pg TEQ/m^3
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1	0.01	0.01
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	0.5	0.011	0.0055
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.1	0.006	0.0006
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.1	0.01	0.001
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.1	0.019	0.0019
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.001	0.15	0.0015
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin	0.001	-	-
2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.1	0.11	0.011
2,3,4,7,8-Pentachlorodibenzo-p-dioxin	0.5	0.033	0.0165
1,2,3,7,8-Pentachlorodibenzofuran	0.05	0.024	0.0012

Dioxin/Furan Isomers of Concern	International Toxicity Equivalency Factors (I-TEFs)	Concentration pg/m^3 (Analytically measured)	Toxicity Equivalent (TEQ) pg TEQ/m^3
1,2,3,4,7,8-Hexachlorodibenzofuran	0.1	0.03	0.003
1,2,3,6,7,8-Hexachlorodibenzofuran	0.1	0.016	0.0016
1,2,3,7,8,9-Hexachlorodibenzofuran	0.1	0.016	0.0016
2,3,4,6,7,8-Hexachlorodibenzofuran	0.1	0.007	0.0007
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	0.047	0.0047
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	0.008	0.0001
1,2,3,4,6,7,8,9-Octachlorodibenzofuran	0.001	-	-
TOTAL TOXICITY EQUIVALENT			**0.06088***

* Sum of toxicity equivalents of individual isomers.

The I-TEF scheme is intended to be used with isomer specific analytical results. In cases where results are reported by congener group only, staff at MOE's Standards Development Branch should be contacted for appropriate procedures to convert non-isomer specific data to TEQs.

10) In the 'AAQC Limiting Effect' column (ie. Table 1) when entries are separated by a semi-colon (eg. odour; irritant; odour for the contaminant butanol, n-) then these apply consecutively to the numbers in that row (ie. 770, 15000 and 3100 respectively); entries separated by '&' or a '/' generally apply to a single number which protects against both effects listed.

11) There are several regulation pertaining to ozone depleting substances. Ozone depleting substances are those substances governed by Part VI of the *Environmental Protection Act* (EPA) (1992) and regulations under the Act (ie. Regulations 851/93; Regulation 189/94). The chlorofluorocarbons (CFCs) in Part VI of the EPA are referenced in the list of AAQCs as "Part VI EPA" and are included for information purposes. The refrigerant regulation (Regulation 189/94) further indicated all CFCs, HCFCs, and HFCs.

Appendix B
Regulation 346 Dispersion Programs

List of Routines:

1. Source Data Manager
2. Point of Impingement Data Manager
3. Maximum Ground Level Concentration
4. Concentration at Points
5. Required Stack Height
6. Isopleths
7. Contour Printout
8. Contour Plot
9. General Concentration Plot
10. Interpolation

Typical Inputs:

Input default values are displayed within square brackets.

1. Titling Information

   e.g. Date, Title. All are optional. Be sure, though, to enter an output filename as the first input or else the program output will default to the printer.

2. Point/Virtual Source

   Indicates whether the source is a point source (e.g. a stack) or a virtual source (e.g. emission from a building vent).

3. Emission Rate

   In grams/second. For a single source, concentration (in ug/m^3) is directly proportional to the emission rate.

4. Stack Height

   Height from ground level to top of stack.

5. Stack Diameter

   Enter the INNER stack diameter.

6. Stack Exit Gas Velocity

   Can be computed from flow rate and stack diameter.

Typical Inputs (Cont'd):

7. Coordinates

   Arbitrarily define (0,0) at, for examples, the location of the largest source. Alternatively (0,0) could be the location of the lower left corner of the property. All other coordinates are in metres, with the X-axis often chosen parallel to a bordering roadway.

8. Building Width/Length/Orientation

   The building width is the shorter dimension. The building length is the longer dimension. The orientation is the acute angle formed by the building length intersecting the X-axis (default of 0 degrees). A counterclockwise rotation increases the orientation.

9. Open/Closed Receptor

   Used when entering an elevated (i.e. above ground level) receptor. A closed receptor will only allow concentration to be computed at the height specified. An open receptor will allow a search from ground level to the height specified for the maximum concentration at that (x,y) location.

Description and Objective

1. Source Data Manager

   Used to input the source and property line information in advance of running the concentration program. The output is stored in a file for later editing or use. This routine is essential if a property line is to be defined. It can also save a lot of typing time if multiple sources are to be run more than once.

2. Point of Impingement Data Manager

   Used to input the points of impingement in advance of running the concentration program. The output is stored in a file for later editing or use. This routine is not essential, but can save a lot of typing time if multiple receptors are to be run more than once.

3. Maximum Ground Level Concentration

   Used to compute the maximum ground level concentration from any combination of sources. If the property line has been defined, the program computes the maximum concentration off-property and on the property line. No point of impingement data is required.

4. Concentration at Points

   Used to compute the maximum concentration from any combination of sources at any combination of points of impingement. Both source and point of impingement data are required as input.

5. Required Stack Height

   Used to compute the height of stack required so that the maximum concentrations at ground level, at the property line and at points of impingement meet a specified standard. The program computes the height for only 1 source at a time.

6. Isopleths

   Used to compute concentration isopleths for any combination of point sources and virtual sources. The isopleths are computed over a grid superimposed over a vertical or horizontal plane. You may specify a particular stability, wind direction and wind speed. The result, stored in non-readable form, can be printed using Contour Printout or plotted using Contour Plot.

Description and Objective (Cont'd.)

7. Contour Printout

   Used to print the results of an Isopleth or Interpolation run in readable form. Can be used to view contour results if a plotter is not available.

8. Contour Plot

   Used to plot the contours of a file created by Isopleth or Interpolation. The result can be routed to a plotter or to an output file (in non-readable form) for later plotting.

9. General Concentration Plot

   Used to compute and plot concentrations for any combination of sources. The concentrations are plotted along a line between two arbitrary endpoints. You may specify a particular stability, wind direction and wind speed. The result can be outputted to a plotter or to an output file (in non-readable form) for later plotting.

10. Interpolation

    Used to compute values over a regularly spaced, points. The output is written to a file in non-readable form. The file can be subsequently outputted using Contour Printout or plotted using Contour Plot.

Appendix C
CASE STUDY I:

Description

Acme Furnishings manufactures furniture. The production steps include shaping the wood components, applying paint and varnish to the components and assembling the furniture.

A sketch of the facility is attached as Figure 1. The figure identifies the sources in the plan view with the Source Reference Numbers 1, 2 & 3

Some components are finished by dipping them in a tank filled with varnish and then allowing them to drip dry. The tank is topped up with varnish each day.

The freshly dipped components are hung in a drying area which is also served by a separate ventilation system.

Other components are painted in a spray booth prior to assembly. The spray booth is equipped with paint filters to collect any over-spray. This spray booth is designated source Number 2.

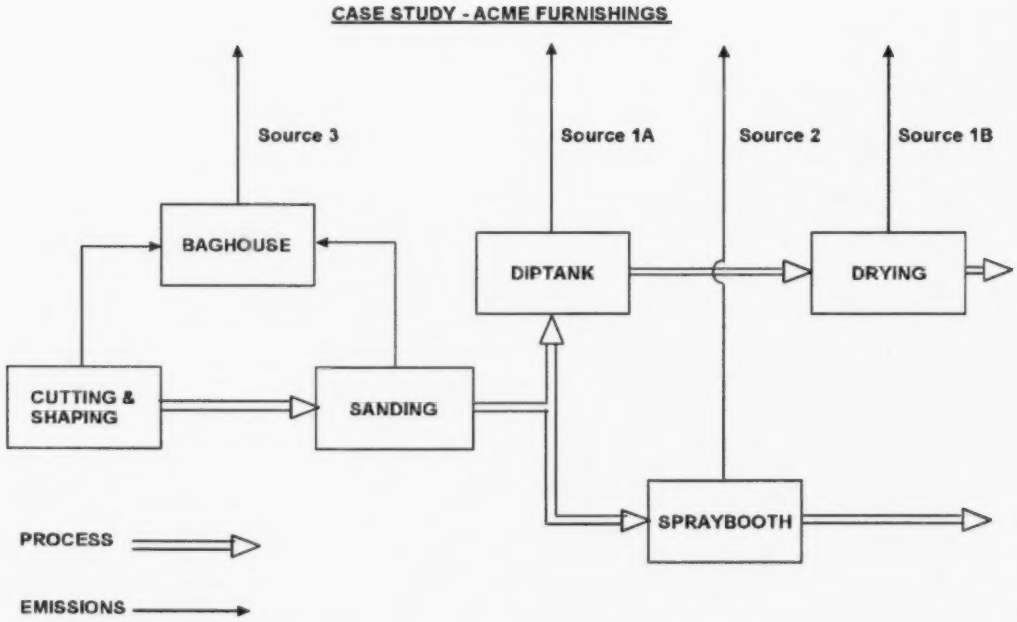
The company operates two cutting and shaping areas and two sanding stations that are all served by a baghouse filter that filters the sawdust from the air collected by hoods from these operations. This baghouse is designated as Source Number 3.

Emission Summary Preparation:

Source Reference and Description

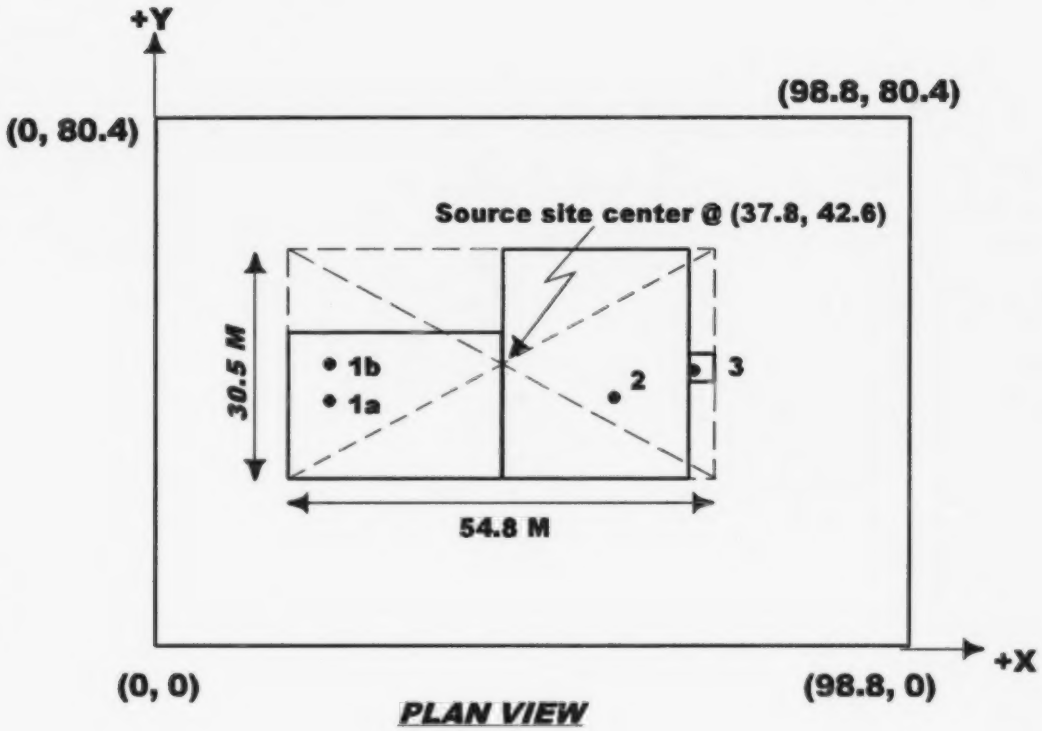
The dip tank varnish application is a distinct source from which the volatile component of the varnish will be emitted. There is no reason to expect the non-volatile component to be emitted because the only mechanism for emission is evaporation. The volatile components in the varnish are: xylene, toluene, and n-Butyl acetate. This process is designated Source Number 1. All the volatile emissions will be emitted through the stack serving the tank (1A) or the stack serving the drying area (1B).

The spray booth will be designated Source Number 2. The volatile components in the paint are xylene and toluene. The spray booth is equipped with paint filters to collects any over-spray of non-volatile material. The spraying operation minimizes over-spray and the paint filters are composed of a paper filter that captures 99% of the particulate.

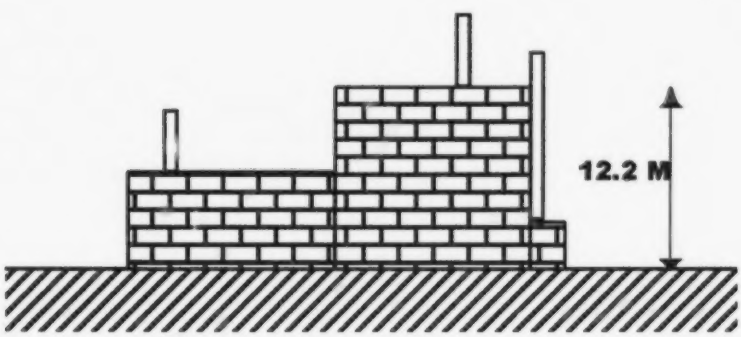


PROCESS SCHEMATIC

Figure C1: ACME Furnishings, Case Study I



PLAN VIEW



ELEVATION VIEW

The baghouse serving the cutting, shaping, and sanding operations will be a source of sawdust and is designated as Source Number 3. Sawdust which is considered to be suspended particulate matter.

Identified on the sketch of the facility, Figure 1, are sources in the plan view with the Source Reference Numbers 1, 2 & 3

Stack Parameters:

The following parameters were determined for each of the stacks identified in the Figure 1:

- volumetric flow-rate of exhaust gas referenced to the exhaust gas temperature;
- stack diameter;
- stack height above roof;
- stack height above grade;

Emission Rate and Estimation Technique

Source 1 - Dip Tank for surface coating

The Mass Balance approach is used to generate an emission rate based on the conservative assumption that 100% of the volatile material used in the process is emitted to the atmosphere at the rate that it is applied. A make up of 40 litres of thinned solvent based varnish is added to the tank each day. The tank is used continuously for 4 hours each day.

Therefore the usage rate is 40/4 = 10 litres per hour
or
0.0028 litres per second

The volatile composition of the varnish in the tank is 1 litre of thinner added for every 4 litres of varnish.

The varnish has a weight of 1100 grams per litre and has the following composition of volatile components.

% in Coating	**Volatile Component**
30%	Xylene
10%	Toluene
5%	n-Butyl acetate

The thinner is 100% xylene and has a weight of 800 grams per litre.

Together the mixture of 1:4 thinner to varnish yields a combined weight of 1040 grams per litre. Given a usage rate of 0.00278 litres per second the resultant mass usage rate is 2.89 grams per second. The composition of the various volatile components in the combined mixture can be calculated using a weighted average.

The emission rates calculated in the following table are based on the conservative assumption that 100% of the volatile material is emitted at the rate it is used.

The percentage of each of the volatile components in the paint is shown along with the resultant emission rate in the following table. The emission rates calculated are based on the conservative assumption that 100% of the volatile material is emitted at the rate it is used.

% in Composition	Contaminant	Emission Rate
		(g/s)
44% (1)	Xylene	1.271 (2)
8%	Toluene	0.231
4%	n-Butyl acetate	0.116

(1) [(30% x 4) + (100% x 1)]/(1+4) = 44%
(2) 44% x 2.89 = 1.271 g/s

Since the estimate is based on a conservative approach the Data Quality can be specified as Conservative.

Source 2 - Spray Booth

The Mass Balance approach is used to generate an emission rate based on the conservative assumption that 100% of the volatile material used in the process is emitted to the atmosphere at the rate that it is applied.

The maximum paint usage rate is 4 litres per hour or 0.0011 litres per second.

The paint has a weight of 1200 grams per litre grams per litre.

Given a usage rate of 0.0011 litres per second the resultant mass usage rate is 1.33 grams per second.

The composition of the volatile components in the paint are listed along with the resultant emission rate

The emission rates calculated in the following table are based on the conservative assumption that 100% of the volatile material is emitted at the rate it is used.

% in Composition	Contaminant	Emission Rate
		(g/s)
20%	Xylene	0.267
10%	Toluene	0.133
20%	Ethylene glycol butyl ether	0.267

Since the estimate is based on a conservative approach the Data Quality can be specified as Conservative.

Source 3 - Baghouse serving wood finishing operation

The baghouse serves four separation collection hoods and has a total flow rate of 4000 cfm or 1.89 m^3/s. The manufacturer has guaranteed an Emission Factor of 20 mg of wood dust per m^3 of flow (supported by a properly documented source test) through the baghouse for this specific application. Therefore the emission rate is 37.8 mg/s of sawdust.

Since the estimate is based on guaranteed Emission Factor the Data Quality can be specified as USEPA "C"

Percentage of Overall Emission

The percentage of overall emission is the percent ratio of a source's emission rate to the overall emission rate of a particular contaminant. For example toluene is emitted from Source 1 (0.231 g/s) and Source 2 (0.133 g/s) with the resultant overall emission 0.354 g/s. Thus for source 1 the Percentage of Overall Emission for toluene will be 0.231/0.354 which is 65%.

The following Source Summary Table is presented in the proper format.

SOURCE SUMMARY TABLE

Source Identifier	Description	Source Data				Emission Data				
		Flow	Diameter	Height Above Grade	Height Above Roof	Contaminant	Emission Rate	Data Quality	Estimation Technique	Percentage of Overall Emission
		(m^3/s) (deg C)	(m)	(m)	(m)		(g/s)			
1A & 1B	Dip tank for varnish	1A 0.94 20	0.2	9.45	1.83	Toluene	0.231	Cons	MB	63%
						Xylenes	1.271	Cons	MB	83%
		1B 1.3 20	0.2	8.62	1.0	n-Butyl acetate	0.116	Cons	MB	100%
2	Paint spray booth	0.47 20	0.15	14	1.83	Ethylene glycol butyl ether	0.267	Cons	MB	100%
						Toluene	0.133	Cons	MB	37%
						Xylenes	0.267	Cons	MB	17%
3	Wood finishing baghouse	1.42 20	0.2	13.1	0.91	Particulate	0.038	USEPA "C"	EF	100%

Dispersion Calculation

Figure C1 shows plan and elevation views for case study #1; ACME Furnishing. The building is shown to have several sections of the roof with different heights above ground level. The building height used in the modeling assessment is the largest roof height of any main section of the building. A small penthouse would usually not be considered in determining the largest roof height for use in the Regulation 346 dispersion model. For the example in Figure C1, a large portion of the building has a roof height of 12.2 m. This is the building height to use in the calculation.

Since all three of the stacks in this example have heights above ground level which are less than 2 times the building height, all three emission sources are treated as virtual sources for the dispersion modeling. The emissions are then treated as a volume source mixed over the height and width of the building with the emission release location being the centre of a rectangle which encloses the building. Since all three emission sources are virtual sources on one building, the emissions of each contaminant can be summed as shown in the Emission Summary Table (Table C4).

The plan view of Figure C1 shows a rectangle drawn to enclose the sections of the building. The virtual source emissions are treated in the dispersion model as being released at the centre of the building shown on the plan view. The length and width of the rectangle are shown on the plan view. Also shown on this diagram are the locations of the property lines around ACME Furnishing. Since the Point of Impingement concentrations are calculated only off-property for industrial facilities, this information on the property line is required for the dispersion modelling. In this example, the (0,0) location was chosen as the lower left hand corner of the property with all other dimensions, including the centre of the building measured relative to this location.

For a virtual source, only two of the routines in the Regulation 346 dispersion model need to be run. These are Program #1: Source Data Manager and Program #3: Maximum Ground Level Concentration.

Source Data Manager

Figure C2 gives a screen printout for the Data Base Manager where the Coordinates of the facility property line and the virtual source characteristics are inputted. The information for this example is:

(1) Input descriptive information (Note 'in' command initiates the process)

(2) Input property line corners for the facility.

(3) Source type is virtual in this case (i.e., type 2)

(4) Input dimension and emission information from Figure A1.

Height	12.2 m
Emission Rate	1 g/s (Note: The actual emission rates for each compound could be used here but using 1 g/s gives a dispersion factor which can be multiplied by the emission rates in the Emission Summary Table [Table C4] to give concentrations of each contaminant.)
Width	30.5 m
Length	54.9 m
Orientation	0 ° (Note: Orientation for a building with its length parallel to the x axis is 0 ° while a building with its length perpendicular to the x axis would have a 90 ° orientation.)
Location of Building:	x 37.8 m
	y 42.6 m

Since the virtual source emissions all come from one building there is only one source treated in the dispersion model.

(5) When the program asks for Source #2 press return. This tells the program that there are no other sources.

(6) Give a file name in which the above data is stored: acme

(7) Press return to exit from the program.

Figure C2: Sample input steps of Source Data Manager to setup ACME Furnishings as a virtual source

```
                    SOURCE DATA BASE MANAGER
                         VERSION 2.00

Command [ ] >In
First enter ten lines of descriptive information
0 [ ] >ACME Furnishings
1 [ ] >
2 [ ] >
3 [ ] >
4 [ ] >
5 [ ] >
6 [ ] >
7 [ ] >
8 [ ] >
9 [ ] >
Do you want to define the property line? [no] >y
 Coordinates of point  1 (m,m)? [end] >0,0
 Coordinates of point  2 (m,m)? [end] >0,80.4
 Coordinates of point  3 (m,m)? [end] >98.8,80.4
 Coordinates of point  4 (m,m)? [end] >98.8,0
 Coordinates of point  5 (m,m)? [end] >
Entering data for source  1
Type of source? (1=point source, 2=virtual source [       0] >2
 Virtual source height (m) [     .00] >12.2
 Emission rate (,units)    [     .00] >1
 Source width (m)          [     .00] >30.5
 Source length (m)         [     .00] >54.9
 Source orientation (deg)  [     .00] >0
 x coordinate (m)          [     .00] >37.8
 y coordinate (m)          [     .00] >42.6
Description [ ] >
Entering data for source  2
Type of source? (1=point source, 2=virtual source [       2] >
Output file name (DOS format) [ ] >acme
Command [ ] >
```

Maximum Ground Level Concentration

The Maximum Ground Level Concentration Program is then run. Figure C3 is a printout of the input screen and the output from the model run. The information for the input is:

(1) Output file name: If a file name is given the model output will be stored in that file. If no file name is given, the model results will be sent directly to the printer to which the PC is connected.

(2) Application information if desired.

(3) Give the file name of the input data created above in the Source Data Manager: acme.

The output screen gives the following information:

(1) The input file name is listed.

(2) The virtual source characteristics are listed.

(3) The section entitled Single Source Maximum Ground Level Concentrations gives the highest values anywhere including on the facility's property for two dispersion stability types (Stabilities C and D). Since on-property values are not assessed for industrial sources, this section of the output sheet is not relevant.

(4) The last two sections give the maximum calculated concentrations along the property line and at locations outside the property. The larger of these two concentrations is the value used as the dispersion factor. For virtual sources the highest concentration will be along the property line. In this example the value was 365.39 $\mu g/m^3$. The other data listed are the location of the maximum and the meteorological conditions used to calculate the maximum concentration.

POI Concentration

The half hour POI concentration for a contaminant will be the product of the Dispersion Factor and the overall emission rate of that contaminant. For example the overall emission rate of xylene is 1.538 g/s which results in a POI Concentration of 561 ug/m^3 (1.538 x 365)

Figure C3: Sample Input steps of Maximum Ground Level Concentration run for ACME Furnishings. Also shown is the model output file

Input Screen

```
                    MAXIMUM GROUND LEVEL CONCENTRATION
                              VERSION 2.00
Log File (DOS format) [prn] >acme
 Date:            [ ] >
 Application No:  [ ] >
 Reviewer:        [ ] >
 Title            [ ] >
Notes/Remarks [ ] >
Input file name for stack data (DOS format) [.STK] >acme
```

Output Screen

```
                    MAXIMUM GROUND LEVEL CONCENTRATION
                              VERSION 2.00

 Data from file: acme.STK

                            Virtual Sources

   Number    Height   Emission      Width     Length      Angle       X       Y
                        Rate
               m       gm/s          m         m          deg        m       m

      1      12.2       1.00        30.5      54.9        .0        38.     43.


          Single Source Maximum Ground Level Concentrations

       Source Stability      Maximum      Distance     Wind Speed
                          Conc  (ug/m3)      (m)          (m/sec)

         1         C        270.58           28.          5.000
                   D        395.25           28.          5.000

  Maximum off-property ground level concentration  358.24     ug/m3
 Stability                                            D
 Wind direction                                    181.087 deg
 Wind speed                                          5.000 m/s
 Coordinates                              -4.0      41.8 (m)

 Maximum Concentration along the property line     365.39     ug/m3
 Stability                                            D
 Wind direction                                    181.201 deg
 Wind speed                                          5.000 m/s
 Coordinates                                0.       42. (m)
```

Percentage of Criteria

The percentage of criteria is the percent ratio of the POI Concentration for a contaminant to the Criteria for that contaminant. For example the POI Concentration for xylene is 561 ug/m^3 and the Criteria is 2300 ug/m therefore the Percentage of Criteria will be 24% (561/2300)

The following Emission Summary Table is presented in the proper format.

EMISSION SUMMARY TABLE

Contaminant	CAS	Emission Rate	POI Concentration	MOE Criteria	
		(g/s)	(ug/m^3)	(ug/m^3)	
Ethylene glycol butyl ether	111-76-2	0.267	97	350	28%
Toluene	108-88-3	0.364	133	2000	7%
Xylenes	1330-20-7	1.538	561	2300	24%
n-Butyl acetate	123-86-4	0.116	42	735	6%
Particulate		0.038	14	100	14%

Appendix D
CASE STUDY II:

Description

ABC Plastics fabricates fibreglass reinforced plastic panels.

The process consists of mixing a formaldehyde based resin in a vented vessel. The vent is connected to a tall discharge stack.

The resin is loaded in to a sheet-forming machine that saturates a paper felt with the resin, which is then sandwiched between two plastic films. The product is then passed through an electric radiant heat oven to cure the resin.

The forming machine and curing oven are both served by separate collection hoods which discharge to the same stack as the mixing vessel.

A sketch of the facility is attached as Figure D1, the figure identifies the source in the plan view with the Source Reference Number 1.

Emission Summary Preparation:

Source Reference and Description

The mixing vessel, sheet- former and cure oven together discharge from the only stack at the facility and will be identified as Source 1. A three production steps can be considered one source because the emission rate is calculated based on assessing the mixing, pressing and curing processes together as a whole.

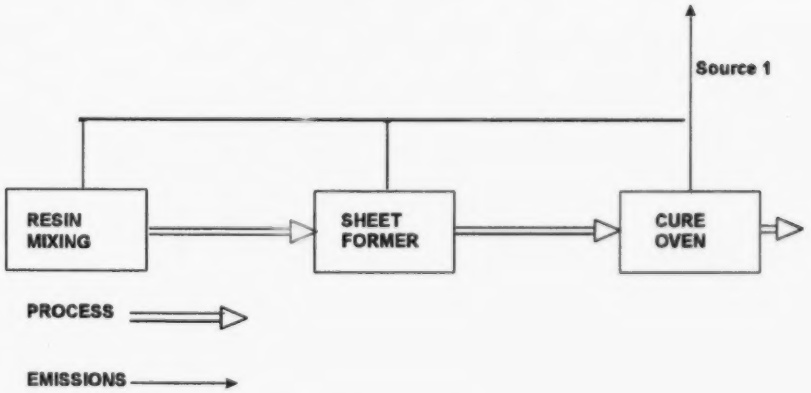
The resin used contains a mixture of high molecular weight organic solids and liquids along with a small amount of sulphuric acid. The only emissions expected are formaldehyde and sulphuric acid.

Stack Parameters:

The following parameters were determined for each of the stacks identified in the Figure 1:

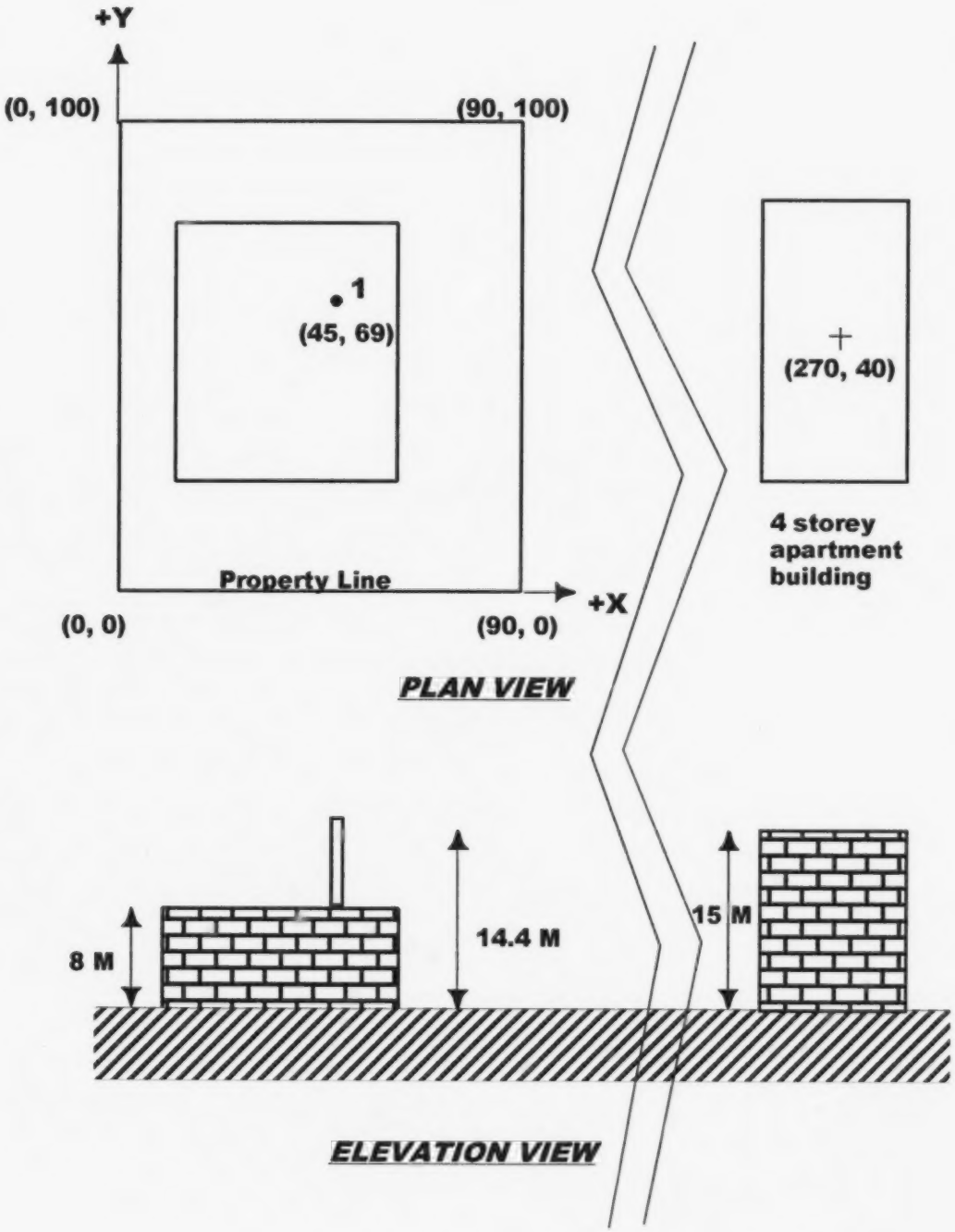
- volumetric flow-rate of exhaust gas referenced to the exhaust gas temperature;
- stack diameter;
- stack height above roof;
- stack height above grade;

CASE STUDY - ABC PLASTICS



PROCESS SCHEMATIC

Figure D1: ABC Plastics, Case Study II



Emission Rate and Estimation Technique

Source 1 - Resin Mixing, Forming and Curing

Formaldehyde:

A source testing program was instituted to measure the concentration of formaldehyde in the stack. The testing was performed in accordance with a referenced source test protocol. The instrumentation used was sensitive down to 5 mg/m^3 of formaldehyde. Of the 10 readings made over several days the average calculated emission rate was 57.6 mg/s and the standard deviation was 4.6 mg/s. Assuming normal distribution and using a t distribution with a 95% confidence interval the concentration will 57.6 mg/s plus or minus 6%.

Since the estimate is based on a Non-conservative treatment of Engineering Calculation the Data Quality must be quantified and reported for non conservative estimates. A reasonable accuracy estimate is 6% .

Sulphuric Acid:

The process mixes and uses 500 kilograms of resin per hour. The resin contains 500 grams of sulphuric acid. Therefore the maximum usage rate of sulphuric acid is:

$500/60^2 = 0.13$ g/s

Assuming that 100% of the sulphuric acid is emitted to the atmosphere results an a conservative emission estimate of 0.13 g/s.

Percentage of Overall Emission

The percentage of overall emission is the percent ratio of a source's emission rate to the overall emission rate of a particular contaminant. Since there is only one source the Percentage of Overall Emission will be 100%.

The following Source Summary Table is presented in the proper format.

SOURCE SUMMARY TABLE

Source	Description	Source Data				Emission Data				
Identifier										
		Flow	Diameter	Height Above Grade	Height Above Roof	Contaminant	Emission Rate	Data Quality	Estimation Technique	Percentage of Overall Emission
		(m^3/s)	(m)	(m)	(m)		(g/s)			
		(deg C) (m/s)								
1	Resin Mixing, Forming and Curing	2.0 (m^3/s) 20 deg. C 14.4 m/s	0.42	14 .4	8	formaldehyde	0.057	6%	EC	100%
						sulphuric acid	0.13	Cons.	MBC	100%

Dispersion Calculation

Figure D1 shows plan and elevation views for ABC Plastics. In this example, the elevation view shows that the stack is more than 2 times the building height and it should then be treated as a point source in the Regulation 346 dispersion model. Correspondingly the source information needed in this case will be stack characteristics.

As was shown for Case Study 1, the corners of the property are given in the plan view diagram with (0,0) being the lower left corner of the property. The Maximum Ground Level Concentration program will use the property line information to perform calculations only off of the facilities property.

Also shown on Figure D1 is a four story apartment building located several hundred metres from the facility. Since the apartment building is 15 m high, the plume from the stack could impinge on this structure possibly giving higher concentrations then would be calculated at ground level. This apartment building will be treated as specific receptor in the Concentration at Points program of the Regulation 346 dispersion model.

For a point source, a total of four of the routines in the Regulation 346 model need to be run. These are Program #1: Source Data Manager, Program #3: Maximum Ground Level Concentration, Program #2: Point of Impingement Manager and Program #4: the Concentrations at Points routine.

Source Data Manager

Figure D2 gives a printout of the Source Data Manager for ABC Plastics. The first portion of the printout shows the entry of the property line co-ordinates. This portion is the same procedure as in case 1. The rest of the printout involves inputting stack characteristics data.

(1) Source type is a point source in this case (i.e., type 1).

(2) Input source characteristic and emission data.

Stack height	14.4 m	
Emission Rate	1 g/s (Note: As in case one, using a 1 g/s emission rate will result in the calculation of a dispersion factor which when multiplied by the emission rate for formaldehyde of 0.057 g/s gives the concentration.)	
Exit velocity	14.4 m/s	
Stack Diameter	0.42 m	
Gas temperature	20 °C	
Location of stack:	x	45 m
	y	69 m

(3) When the program asks for source #2 press return to indicate there is only one source.

(4) Give a file name where the data is stored: abc

(5) Press return to exit.

Maximum Ground Level Concentration

The input screen shown in Figure D3 is identical in format to that described in Case Study 1. The output screen is also identical in terms of the organization of the information. The only difference is that for a point source stack characteristics are listed. For this case the program found a maximum off property ground level concentration of 130.1 $\mu g/m^3$ at coordinates (48 m, 395 m). This maximum concentration occurred for class D stability with a wind speed of 2.235 m/s. This maximum ground level concentration was much larger than the value calculated along the property line of the facility because the plume required about 300 m of travel distance before the main portion of the emissions was mixed to ground level.

Figure D2: Sample input steps for Source Data Manager to set up ABC Plastics as a point source.

```
                    SOURCE DATA BASE MANAGER
                         VERSION 2.00

Command [ ] >in
First enter ten lines of descriptive information
0 [ ] >ABC Plastics
1 [ ] >
2 [ ] >
3 [ ] >
4 [ ] >
5 [ ] >
6 [ ] >
7 [ ] >
8 [ ] >
9 [ ] >
Do you want to define the property line? [no] >y
 Coordinates of point  1 (m,m)? [end] >0,0
 Coordinates of point  2 (m,m)? [end] >0,100
 Coordinates of point  3 (m,m)? [end] >90,100
 Coordinates of point  4 (m,m)? [end] >90,0
 Coordinates of point  5 (m,m)? [end] >
Entering data for source  1
Type of source? (1=point source, 2=virtual source [       0] >1
 Stack height (m)           [     .00] >14.4
 Emission rate (,units)     [     .00] >1
 Exit velocity (m/s)        [     .00] >14.4
 Stack diameter (m)         [     .00] >0.42
 Stack gas temperature (C)  [     .00] >20
 x coordinate (m)           [     .00] >45
 y coordinate (m)           [     .00] >69
Description [ ] >
Entering data for source  2
Type of source? (1=point source, 2=virtual source [       1] >
Output file name (DOS format) [ ] >abc
Command [ ] >
```

Figure D3: Sample input steps for Maximum Ground Level Concentration run for ABC Plastics. Also shown is the model output file echoed on the screen.

```
                              INPUT SCREEN

                      MAXIMUM GROUND LEVEL CONCENTRATION
                                VERSION 2.00
Log File (DOS format) [prn] >abc
File already exists - OK to over-write [yes] >
 Date:              [ ] >
 Application No:    [ ] >
 Reviewer:          [ ] >
 Title              [ ] >
Notes/Remarks [ ] >
Input file name for stack data (DOS format) [.STK] >abc

                              OUTPUT SCREEN

                      MAXIMUM GROUND LEVEL CONCENTRATION

                                VERSION 2.00

 Data from file: abc.STK

                                Point Sources

 Number    Height   Emission      Exit      Diameter     Temp        X        Y
                      Rate       Velocity
              m      gm/s         m/s           m          C          m        m

    1       14.4      1.00       14.4          .4        20.0       45.     69.

          Single Source Maximum Ground Level Concentrations

       Source Stability        Maximum  Distance  Wind Speed
                          Conc  (ug/m3)      (m)     (m/sec)

            1         C       106.99        189.      2.235
                      D       130.09        326.      2.235

 Maximum off-property ground level concentration  130.09     ug/m3
 Stability                                           D
 Wind direction                                   89.542 deg
 Wind speed                                        2.235 m/s
 Coordinates                                47.6   395.1 (m)

 Maximum Concentration along the property line     17.864     ug/m3
 Stability                                           C
 Wind direction                                  236.889 deg
 Wind speed                                        4.235 m/s
 Coordinates                                 0.      0. (m)
```

Figure D4: Sample input steps for Point of Impingement Manager to setup receptor data for Concentration at Points model run

```
                POINT OF IMPINGEMENT DATA BASE MANAGER
                            VERSION 2.00
Command [ ] >in
First enter ten lines of descriptive information
0 [ ] >ABC Plastics
1 [ ] >
2 [ ] >
3 [ ] >
4 [ ] >
5 [ ] >
6 [ ] >
7 [ ] >
8 [ ] >
9 [ ] >
Entering data for point  1
 X coordinate  (m)       [     .00] >270
 Y coordinate  (m)       [     .00] >40
 Height        (m)       [     .00] >15
 Is building open?       [no] >y
Description [ ] >a four story apartment building nearby
Entering data for point  2
 X coordinate  (m)       [  270.00] >
Output file name (DOS format) [ ] >abc
```

Figure D5: Sample input steps of Concentration at Points model run for ABC Plastics

```
                    CONCENTRATION AT POINTS
                         VERSION 2.00

Log File (DOS format) [prn] >abc
File already exists - OK to over-write [yes] >
 Date:             [ ] >
 Application No:   [ ] >
 Reviewer:         [ ] >
 Title             [ ] >
Notes/Remarks [ ] >
Input file name for stack data (DOS format) [.STK] >abc

   1 Sources read from file  abc.STK


Input file name for point data (DOS format) [.PTI] >abc

   1 Points read from file  abc.PTI


Output stored in file:  abc

Do you want to run another case? [no] >
```

Figure D6: Sample output file of Concentration at Points model run for ABC Plastics

CONCENTRATION AT POINTS
VERSION 2.00

Source data from file:

abc.STK

Point Sources

Number	Height	Emission Rate	Exit Velocity	Diameter	Temp	X	Y
	m	gm/s	m/s	m	C	m	m
1	14.4	1.00	14.4	.4	20.0	45.	69.

Point of impingement data from file:

abc.PTI

Points of impingement

No	x (m)	y (m)	z (m)	type	Description
1	270.	40.	15.	open	A four story apartment building nearby

Point of Impingement (m)			Stab	Concentration	Wind Conditions		Height
				(ug/m3)	Direction	Speed (m/s)	(m)
270.	40.	15.	C	111.26	-7.3	2.235	15.0
			D	329.57	-7.3	2.235	15.0

Point of Impingement Manager

Figure D1 shows a 15 m high apartment building located about 200 m from the stack. The plume from the stack can impinge on the side or the top of the apartment building. Since the impingement point is closer to the plume centre line, high concentrations are possible. This program provides data on the locations of specific point of impingement such as an apartment building. The input screen is provided in Figure D4.

(1) Input descriptive information (Note the 'in' command initiates the input of data).

(2) Input the x and y location along with the height of the apartment building. The program then asks:

"Is the building open?" The answer is yes if the windows can open or if balconies exist on the building.

(3) In this example there is only one receptor in the calculation so return is pressed in answer to the x coordinate of the second point. This tells the program that only one receptor is used.

(4) Give a file name where the data is stored: abc.

(5) Press return to exit.

Concentrations at Points

Figure D5 shows the input screen for the Concentration at Points program.

(1) Output file name: Give a file name to which the program output will be stored to retain a file copy of the model results.

(2) Application information if desired.

(3) Input source characteristics file name created in the Source Data Manager: abc.

(4) Input the name of the file in which the information on the points of impingement is stored. This file was created in the Point of Impingement Manager described above: abc.

The output from the program is illustrated in Figure D6 which shows the output sheet. The format of this sheet is similar to that used for the printout of the Maximum Ground Level Concentration program.

(1) Listing of the stack characteristics data,

(2) Listing of the location and other information on the points of impingement studied.

(3) The calculated concentrations (dispersion factor) at the bottom of the page gives the highest concentration for class C and D stabilities. as well as the associated meteorological conditions. The concentration (dispersion factor) to be used is the larger of the two numbers. In this case 329.6 $\mu g/m^3$ was the calculated maximum value. This maximum occurred at the top of the apartment building. Since the dispersion factor calculated at the top of the apartment building is much larger than that calculated from the Maximum Ground Level Concentration program, the value to be used in the assessment is the largest value of 329.6 $\mu g/m^3$.

POI Concentration

The POI concentration for a contaminant is the product of the Dispersion Factor and the overall emission rate of that contaminant.

For example, the overall emission rate of formaldehyde is 0.057 g/s, which results in a POI Concentration of 18.8 $\mu g/m^3$.

The overall emission rate of sulphuric acid is 0.13 g/s, which results in a POI Concentration of 42.8 $\mu g/m^3$.

Percentage of Criteria

The percentage of criteria is the percent ratio of the POI Concentration for a contaminant to the Criteria for that contaminant.

For example the POI Concentration for phenol is 18.8 ug/m^3 and the Criteria is 100 ug/m^3 therefore the Percentage of Criteria will be 18.8%.

The following Emission Summary Table is presented in the proper format.

EMISSION SUMMARY TABLE

Contaminant	CAS	Emission Rate	POI Concentration	MOEE Criteria	
		(g/s)	(ug/m^3)	(ug/m^3)	
Formaldehyde	7664-93-9	0.057	18.8	65	29%
Sulphuric Acid	50-00-0	0.13	42.8	100	43%

Appendix E
CASE STUDY III:

Facility Description

Phair Liners manufactures chrome-magnesite refractory brick for use as furnace lining.

A sketch of the facility is attached as Figure E1, the figure identifies the source in the plan view with the Source Reference Number 1. There are no nearby buildings and the facility is located in an industrial area with no buildings higher than either of these buildings on the site for several kilometres.

The process has the major manufacturing steps described in the attached process diagram Figure E2. The specific operations are crushing and grinding the raw material, a chrome ore, drying the material, mixing it with an organic binder to form bricks which are then fired in a kiln, the fired bricks are machined and packaged in finishing operations

Source Identification:

There are some obvious pollution sources at the facility, there is a baghouse that draws particulate emissions from the stations where the fired brick is finished and packaged for sale, this was designated Source 1.

There is the kiln building where the dried bricks are fired which is designated Source 2. The kiln building operates 24 hours a day with one of two identical kilns operating at all times. Two kilns are never operated simultaneously and the same stack serves both.

The organic binder is burned off of the formed bricks as the kiln heats up, during the period when the bricks are fuming a fume incinerator is operated.

The crushing , grinding, mixing of the raw material takes place in enclosed machines that are served by a baghouse which is designated Source 3.

The raw material is dried in a rotary drier served by a cyclone followed by a baghouse control, this source is designated Source 4.The drying building operates one to two shifts a day for an annual average of 10 hours a day.

Site Plan

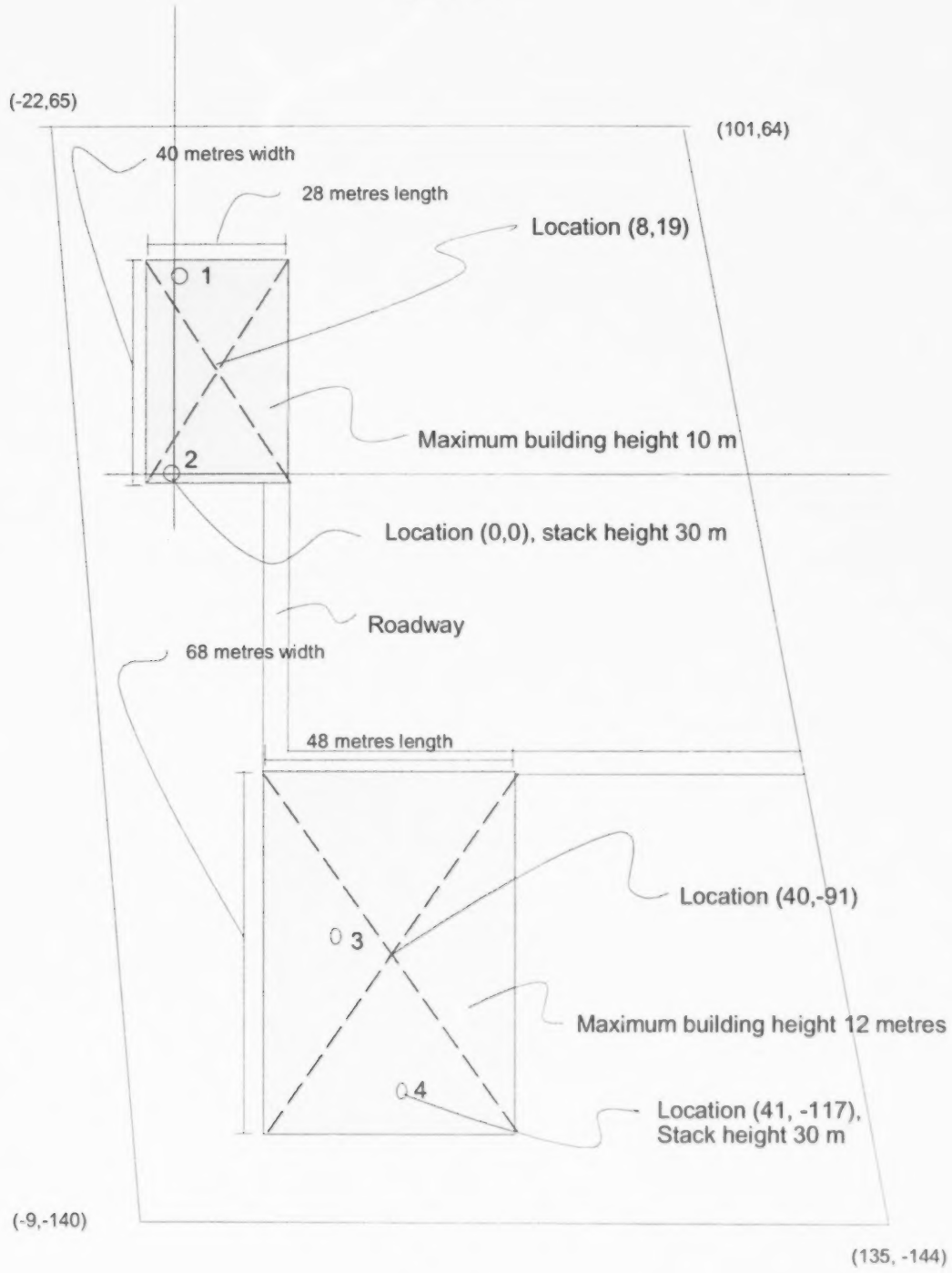


Figure E1

Site Plan

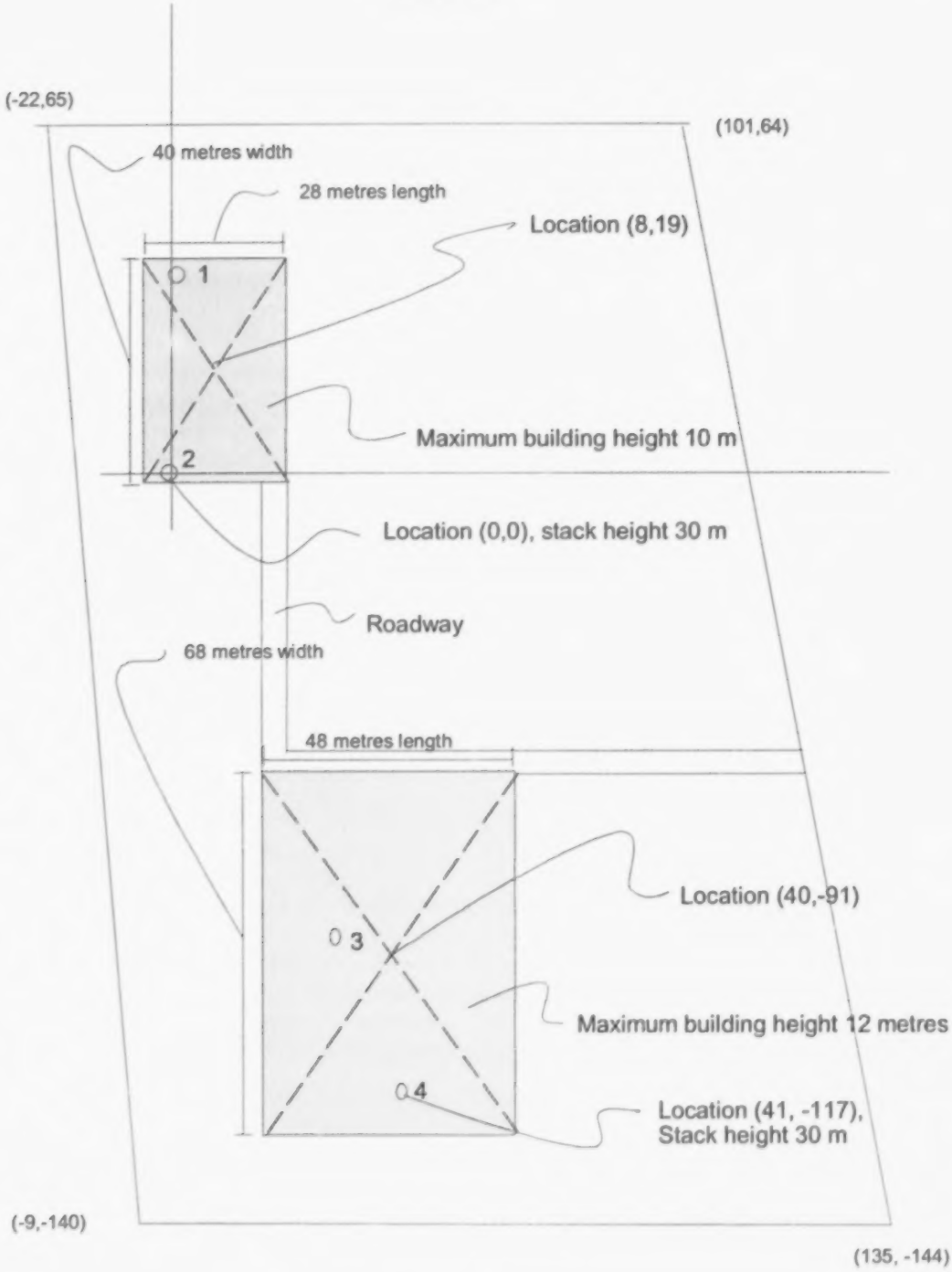


Figure E1

Process Flow Diagram

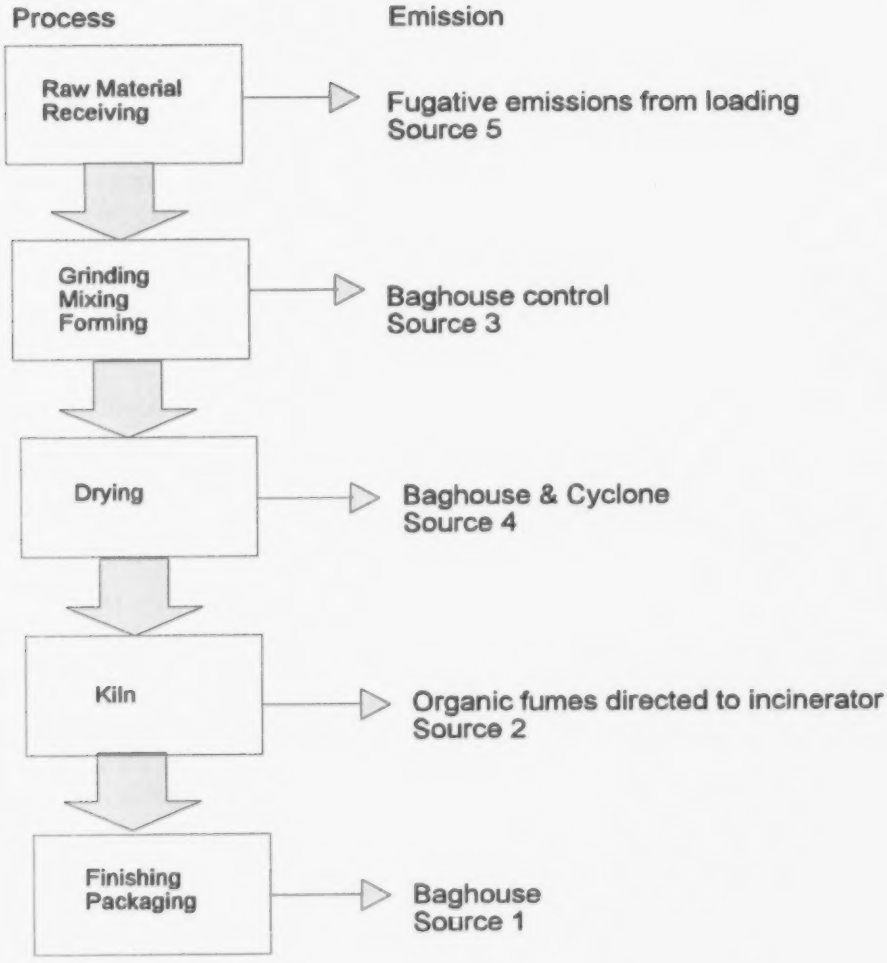


Figure E2

Fugitive Sources:

All the manufacturing processes take place in enclosed vessels with ventilation systems

The raw material is delivered in an enclosed truck and the trucks are washed as they leave the loading station. The roadways are paved and the company has they periodically cleaned with a sweeper. The loading of the raw material occurs in a semi-enclosed outside station attached to the dryer building where the ore is drop loaded into an open hopper. This loading operation constitutes a fugitive source which will be designated Source 5. The unloading operation takes about ten minutes during which time 15 tonnes of ore are dropped off. Over the course of a year 60,000 tonnes are unloaded, loading is delayed if the conditions are too windy to keep the air relatively calm in the loading area.

Although roadway dust for manufacturing facilities are not usually classified a significant source, for this facility the road dust may contain elevated chrome and therefore may be a significant source of chrome. An assessment of whether or not the road dust is significant source should be made.

Maximum emission scenario:

The peak emission will be calculated based on Sources 1,2,3, and 4 all operating at capacity simultaneous with a the fugitive emissions associated with the drop unloading of raw material

Annual emission scenario.

The plant operates the kiln building on three eight hour shifts five days a week, 50 weeks a year. The drier building operates one to two shifts a day for an annual average of ten hours a day, five days a week, 50 weeks a year. During a year the company processes 60,000 tones of ore into refractory brick.

Emission Estimates

The following worksheets develop and document the emission estimates for each source. For each source the available data on known emissions was examined to identify the contaminants being emitted. The emission estimating procedure was referenced and data Quality was assessed and recorded..

The results from each of the following worksheets is then tabulated on the Source Summary Table.

Source 1

Bag house serving product finishing and packaging

Role in peak emission scenario - constant emission 8-12 hours a day

Role in annual emission scenario - constant emission 2500 hours per year

Baghouse Flowrate: 1500 cfm
0.71 m^3/s

Emission factor: 0.01 g/m^3

Based on the manufacturer's guarantee supported by a Source Measurement documented as done in compliance with US-EPA protocol and accepted by the Material Safety Data Sheet supplied with the Chrome-Ore raw material indicates the following composition for the raw material:

Contaminant	Percentage in Raw Material
Chromium Oxide	48.0%
Magnesium Oxide	11.3%
Ferric Oxide	29.0%
Aluminum Oxide	15.0%

Mass Ratio of chromium oxide to chromium: 1.46

Source 1 Summary

Contaminant	CAS	Peak Emission Rate	Annual Emission Rate	Data Quality	Estimation Technique	
		(g/s)	(kg)	(g/s)	(g/s)	
Total Suspended Particulate		0.007	64	USEPA "C"	EF	1.4%
Chromium	7440-47-3	0.002	21	USEPA "C"	EF	1.2%
Magnesium Oxide	1309-48-4	0.001	7	USEPA "C"	EF	23.7%
Ferric Oxide	1309-37-1	0.002	18	USEPA "C"	EF	23.7%
Aluminum Oxide	1344-28-1	0.001	10	USEPA "C"	EF	23.7%

Source 2

Uncontrolled Tunnel kiln

Role in emission scenario - constant emission of one kiln 24 hour a day, with incinerator firing

Role in annual emission scenario - constant kiln emission 24 hours a day, 250 days per year incinerator fires 4 hours per day

Max. Kiln Production Rate:	2000 kg/hr 2 Mg/hr
Max. Kiln Firing Rate:	6,000,000 kJ/hr 37,000 kJ/m^3 natural gas 162.2 m^3/hr
Incinerator Firing Rate:	2,000,000 kJ/hr 37,000 kJ/m^3 natural gas 54.1 m^3/hr

The following emission factors where available from the US-EPA

Contaminant	Emission Factor	Units
Refractory Manufacturing AP-42 Chapter 11.5, 1995		
Total particulate	0.41	kg/Mg
PM-10	0.34	kg/Mg
Total Chromium	0.13	kg/Mg
Hexavalent Chromium	8.70E-03	kg/Mg
Natural Gas Combustion AP-42 Chapter 1.4, 1985		
Nitrogen Oxides	1600	kg/10^6 m^3

NOTE: the emission of other contaminants from the natural gas combustion where not considered significant since experience has indicated that the ultimate impact on the POI will be very small. (see example "AP-42 Emission Factor on page 12 of the Procedure)

The organic emissions from the volatilization of the urea-formaldehyde binder system by the incinerator. Source Measurements were made in accordance with referenced USEPA test protocols. The specific test was accepted by the Massachusetts Department of Environmental Protection. The testing was done on a similar kiln using the same binder system but operating at a production rate of 5000 kilograms per hour with an incinerator operating at similar temperature and retention times. The following table tabulates the maximum emission rates from that source test prorated to the lower production rate of this kiln.

Contaminant	CAS	Peak Emission Rate
		(g/s)
Ethyl benzene	100-41-4	0.0069
Naphthalene	91-20-3	0.0005
Xylenes	1330-20-7	0.0005
Formaldehyde	50-00-0	0.00058
Toluene	108-88-3	0.007
Benzene	71-43-2	0.013

Source 2 Summary

Contaminant	CAS	Peak Emission Rate	Annual Emission	Data Quality	Estimation Technique	
		(g/s)	(kg)	(g/s)	(g/s)	
Total Suspended Particulate		0.228	4920	USEPA "E"	EF	44.9%
PM-10		0.189	4080	USEPA "E"	EF	100%
Chromium	7440-47-3	0.072	1560	USEPA "E"	EF	98.3%
Hexavalent chromium		0.005	104.4	USEPA "E"	EF	99.3%
Nitrogen Oxides		0.10	1643	USEPA "A"	EF	72.7%
Ethyl benzene	100-41-4	0.0069	24.84	Doc.	SM	100.0%
Naphthalene	91-20-3	0.0005	1.8	Doc.	SM	100.0%
Xylenes	1330-20-7	0.0005	1.8	Doc.	SM	100.0%
Formaldehyde	50-00-0	0.00058	2.088	Doc.	SM	100.0%
Toluene	108-88-3	0.007	25.2	Doc.	SM	100.0%
Benzene	71-43-2	0.013	46.8	Doc.	SM	100.0%

Source 4

Rotary dryer equipped with cyclone and baghouse

Role in peak emission scenario - constant emission 8-16 hours a day

Role in annual emission scenario - constant emission 2500 hours per year

Max. Drier Processing Rate: 6000 kg/hr
6 Mg/hr

Constant Drier Firing Rate: 3,000,000 kJ/hr
37,000 kJ/m^3 natural gas
81.1 m^3/hr

The following emission factors where available from the US-EPA

Contaminant	Emission Factor	Units
Refractory Manufacturing AP-42 Chapter 11.5, 1995		
Total particulate	0.15	kg/Mg
Total Chromium	0.064	kg/Mg
Hexavalent Chromium	1.90E-05	kg/Mg
Natural Gas Combustion AP-42 Chapter 1.4, 1985		
Nitrogen Oxides	1600	kg/10^6 m^3

Source 4 Summary

Contaminant	CAS	Peak Emission Rate	Annual Emission	Data Quality	Estimation Technique	
		(g/s)	(kg)	(g/s)	(g/s)	
Total Suspended Particulate		0.250	2250	USEPA "E"	EF	49.2%
Chromium	7440-47-3	0.107	960	USEPA "E"	EF	55.5%
Hexavalent chromium		0.00003	0.285	USEPA "E"	EF	0.7%
Nitrogen Oxides		0.036	324	USEPA "A"	EF	27.3%

Source 5

Fugitive emissions from raw material handling

Role in peak emission scenario - 15 tonnes per truck, ten minutes to unload

Role in annual emission scenario - 60,000 tonnes unloaded per year

Measured Silt Content, Chrome-Ore	
High	20%
Mean	10%
Low	2%

Measured Moisture Content, Chrome-Ore	
High	8%
Mean	5%
Low	2%

The following emission factor is based on US-EPA AP-42 , Chapter 13.2.4, Jan. 1995.
emission factor for fugitive emissions from aggregate handling

U = Air speed inside loading area:	10 kilometres per hour 2.78 m/s
k = Particle size multiplier:	0.74
M = moisture content:	2%
Emission Factor:	0.00160 kg/Mg
Maximum transfer rate:	15 Tonnes per half hour
Annual Transfer Rate:	12000 tonnes per year

Contaminant	Percentage in Raw Material
Chromium Oxide	48.0%
Magnesium Oxide	11.3%
Ferric Oxide	29.0%
Aluminum Oxide	15.0%

Mass Ratio of chromium oxide to chromium: 1.46

Contaminant	CAS	Peak Emission Rate	Annual Emission	Data Quality	Estimation Technique	
		(g/s)	(kg)	(g/s)	(g/s)	
Total Suspended Particulate		0.0134	19.2	USEPA "A"	EF	2.6%
Chromium	7440-47-3	0.0044	6.3	USEPA "A"	EF	2.3%
Magnesium Oxide	1309-48-4	0.0015	2.2	USEPA "A"	EF	44.7%
Ferric Oxide	1309-37-1	0.0039	5.6	USEPA "A"	EF	44.7%
Aluminum Oxide	1344-28-1	0.0020	2.9	USEPA "A"	EF	44.7%

Assume fugitive dumping emissions are significant

Fugitive emissions from road dust

The following emission factor is based on US-EPA AP-42 , Chapter 13.2.1, Oct. 1997 emission factor for fugitive emissions from aggregate handling

Silt loading, sL:	0.4 g/m^2
average vehicle weight, V:	6.4 tonnes
particulate size multiplier, k:	24 g/VKT
vehicle km travelled, VKT:	0.775 kilometres (per half-hour)
peak VKT per second:	0.00043055556 km/s
dust emission factor:	26.3 g/VKT
dust emission rate:	20.4 g/half-hour 0.01131 g/s
Chrome in dust:	4000 ug/g (measured)
Chrome emission rate:	0.000045 g/s

Contaminant	CAS	Peak Emission Rate	Annual Emission	Data Quality	Estimation Technique	Percentage of Overall Emission
		(g/s)	(kg)	(g/s)	(g/s)	
Total Suspended Particulate		0.0134			EF	
Chromium	7440-47-3	0.0045			EF	0.02%

Assume Fugitive road dust emissions are not significant

Source 3

Bag house serving raw material grinding and mixing

Role in peak emission scenario - constant operation 24 hours a day

Role in annual emission scenario - constant operation 24 hours a day, 250 days per year

Flowrate: 2000cfm
0.94m^3/s

Emission factor: 0.01g/m^3

Based on the manufacturer's guarantee supported by a Source Measurement documented as done in compliance with US-EPA protocol and accepted by the Material Safety Data Sheet supplied with the Chrome-Ore raw material indicates the following composition for the raw material:

Contaminant	Percentage in Raw Material
Chromium Oxide	48.0%
Magnesium Oxide	11.3%
Ferric Oxide	29.0%
Aluminum Oxide	15.0%

Mass Ratio of chromium oxide to chromium: 1.46

Source 3 Summary

Contaminant	CAS	Peak Emission Rate	Annual Emission Rate	Data Quality	Estimation Technique	
		(g/s)	(kg)	(g/s)	(g/s)	
Total Suspended Particulate		0.009	204	C	EF	1.9%
Chromium	7440-47-3	0.007	143	C	EF	3.4%
Magnesium Oxide	1309-48-4	0.001	23	C	EF	31.6%
Ferric Oxide	1309-37-1	0.003	59	C	EF	31.6%
Aluminum Oxide	1344-28-1	0.001	31	C	EF	31.6%

SOURCE SUMMARY TABLE

SOURCE ID	DESCRIPTION	SOURCE DATA				EMISSION DATA				
		Stack Gas Flow Rate	Stack Diameter	Height Above Grade	Height Above Roof	Contaminant	Peak Emission Rate	Data Quality	Estimation Technique	Percentage of Overall Emission
		(m^3/s)	(m)	(m)	(m)		(g/s)	(g/s)	(g/s)	
1	Baghouse serving Finishing	0.71 @ 20 deg C.	0.2	2	12	Total Suspended Particulate	0.0071	USEPA "C"	EF	1.4%
						Chromium	0.0023	USEPA "C"	EF	1.2%
						Magnesium Oxide	0.0008	USEPA "C"	EF	23.7%
						Ferric Oxide	0.0021	USEPA "C"	EF	23.7%
						Aluminum Oxide	0.0011	USEPA "C"	EF	23.7%
2	Tunnel Kiln	5.6 @ 150 deg C.	0.45	30	20	Total Suspended Particulate	0.2278	USEPA "E"	EF	44.9%
						PM-10	0.1889	USEPA "E"	EF	100.0%
						Chromium	0.0722	USEPA "E"	EF	98.3%
						Hexavalent chromium	0.0048	USEPA "E"	EF	99.3%
						Nitrogen Oxides	0.0961	USEPA "A"	EF	72.73%
						Ethyl benzene	0.0069	Doc.	SM	100.00%
						Naphthalene	0.0005	Doc.	SM	100.00%
						Xylenes	0.0005	Doc.	SM	100.00%
						Formaldehyde	0.00058	Doc.	SM	100.00%
						Toluene	0.007	Doc.	SM	100.00%
						Benzene	0.013	Doc.	SM	100.00%
3	Baghouse serving Grinding and Mixing	0.94	0.2	2	14	Total Suspended Particulate	0.0071	USEPA "C"	EF	1.4%
						Chromium	0.0023	USEPA "C"	EF	1.2%
						Magnesium Oxide	0.0008	USEPA "C"	EF	23.7%
						Ferric Oxide	0.0021	USEPA "C"	EF	23.7%
						Aluminum Oxide	0.0011	USEPA "C"	EF	23.7%
4	Rotary dryer	7 @ 130 deg C.	0.45	30	18	Total Suspended Particulate	0.2500	USEPA "E"	EF	49.2%
						Chromium	0.1067	USEPA "E"	EF	55.5%
						Hexavalent chromium	0.0000	USEPA "E"	EF	0.7%
						Nitrogen Oxides	0.036036	USEPA "A"	EF	27.27%
5	Fugitive Loading Emissions					Total Suspended Particulate	0.0134	USEPA "A"	EF	2.6%
						Chromium	0.0044	USEPA "A"	EF	2.3%
						Magnesium Oxide	0.0015	USEPA "A"	EF	44.7%
						Ferric Oxide	0.0039	USEPA "A"	EF	44.7%
						Aluminum Oxide	0.0020	USEPA "A"	EF	44.7%

Dispersion Calculation

Figure E1 shows a plan view (with building and stack heights clearly identified for Phair Liners Inc.) The plan indicates that Source 2 is a stack more than twice the maximum building height of the structure it is attached to therefore it will be a point source. Similarly Source 4 will also be a point source. The emissions from Source 1 will be configured as a virtual source while Source 3 and fugitive Source 5 will be lumped together as another virtual source.

Combining the point source parameters (data recorded in Inventory Summary Table) , the virtual source parameters (data recorded on site plan) and the chromium emission rates yields the following dispersion modelling input data set for chromium. A separate data set, and dispersion calculation must be run for each of the identified contaminants.

Virtual Source emitting Source 1

Emission Rate	0.0023 g/s
Height	10 m
Length	28 m in x
Width	40 m in y-direction
Location	8 m in x
	19 m in y-direction

Virtual Source emitting Sources 3 & 5

Emission Rate	0.006713 g/s
Height	12 m
Length	48 m in x
Width	68 m in y-direction
Location	40 m in x
	-91 m in y-direction

Point Source emitting Source 2

Emission Rate	0.07 g/s
Height	30 m
Stack diameter	0.45 m
Area	0.16 m^2
Stack temperature	150 degrees Celsius
Volumetric Flow	5.6 m^3/s
Exhaust velocity	35.21 m/s
Location	0 m in x
	0 m in y-direction

Point Source emitting Source 4

Emission Rate	0.11 g/s
Height	30 m
Stack diameter	0.45 m
Area	0.16 m^2
Stack temperature	130 degrees Celsius
Volumetric Flow	7 m^3/s
Exhaust velocity	44.01 m/s
Location	41 m in x
	-117 m in y-direction

	Source1	Sources 3&5	Source 2	Source 4	
Virtual:					
Height	10	12			m
Width	40	68			m in y-direction
Location	8	40			m in x
	19	-91			m in y-direction
Point					
Height			30	30	m
Stack diameter			0.45	0.45	m
Area			0.16	0.16	m^2
Stack temperature			150	130	degrees Celsius
Volumetric Flow			5.6	7	m^3/s
Exhaust velocity			35.21	44.01	m/s
Location			0	41	m in x
			0	-117	m in y-direction

Contaminant	Emission Rate (g/s)	Emission Rate (g/s)	Emission Rate (g/s)	Emission Rate (g/s)	Output File
Total Suspended Particulate	0.007079	0.020440	0.227778	0.250000	TSP
PM-10	0.000000	0.000000	0.188889	0.000000	PM10
Chromium	0.002325	0.006713	0.072222	0.106667	CHROME
Hexavalent chromium	0.000000	0.000000	0.004833	0.000032	HEX
Nitrogen Oxides	0.000000	0.000000	0.096096	0.036036	NOX
Ethylbenzene	0.000000	0.000000	0.006900	0.000000	EB
Naphthalene	0.000000	0.000000	0.000500	0.000000	NAPTH
Xylenes	0.000000	0.000000	0.000500	0.000000	XYLENE
Formaldehyde	0.000000	0.000000	0.000580	0.000000	FORM
Toluene	0.000000	0.000000	0.007000	0.000000	TOLUENE
Benzene	0.000000	0.000000	0.013000	0.000000	BENZENE
Magnesium Oxide	0.000800	0.002310	0.000000	0.000000	MAGOX
Ferric Oxide	0.002053	0.005928	0.000000	0.000000	FERROX
Aluminum Oxide	0.001062	0.003066	0.000000	0.000000	ALOX

The data set is inputted along with the property line information described in the site plan, using the Source Database Manager in the Regulation 346 Dispersion Modelling Package. The file created by the Source Database Manager is called up in the Maximum Ground Level Concentration Program which creates the following output.

MAXIMUM GROUND LEVEL CONCENTRATION
VERSION 2.00

Data from file: a:\chrome.STK

Point Sources

Number	Height	Emission Rate	Exit Velocity	Diameter	Temp	X	Y
	m	gm/s	m/s	m	C	m	m
3	30.0	.722E-01	35.2	.4	150.0	0.	0.
4	30.0	.11	44.0	.4	130.0	41.	-117.

Virtual Sources

Number	Height	Emission Rate	Width	Length	Angle	X	Y
	m	gm/s	m	m	deg	m	m
1	10.0	.233E-02	40.0	28.0	.0	8.	19.
2	12.0	.670E-02	68.0	48.0	.0	40.	-91.

Single Source Maximum Ground Level Concentrations

Source	Stability	Maximum Conc (ug/m3)	Distance (m)	Wind Speed (m/sec)
1	C	.71648	15.	5.000
	D	.96495	15.	5.000
2	C	1.0329	25.	5.000
	D	1.3998	25.	5.000
3	C	1.4030	476.	2.235
	D	1.5090	843.	2.235
4	C	1.8117	513.	2.235
	D	1.8960	934.	2.235

All Stacks Tested

Maximum off-property ground level concentration		3.6021	ug/m3
Stability		D	
Wind direction		108.892	deg
Wind speed		2.235	m/s
Coordinates	-256.3	751.9	(m)

Maximum Concentration along the property line		1.8593	ug/m3
Stability		D	
Wind direction		280.896	deg
Wind speed		18.235	m/s
Coordinates	46.	-142.	(m)

POI Concentration

Thus the half-hour POI concentration for chromium emitted from Phair Liners Inc. is 3.602 µg/m^3. resulting from an emission of 0.009 g/s of chromium.

Percentage of Criteria

The percentage of criteria is the percent ratio of the POI Concentration for a contaminant to the Criteria for that contaminant. For chromium, the half-hour POI Concentration 3.62 ug/m^3 and the half-hour POI Criteria is 5 ug/m^3. Therefore, the Percentage of Criteria will be 72.4.

For chromium the half-hour POI Concentration, the half-hour POI Criteria and the Percentage of Criteria for chromium can be recorded in the Emission Summary Table along with the Annual Emission Rate in kilograms

Confirmation of assumption of road dust chrome emissions as insignificant

% of criteria	72.4%
total emission of chrome	0.0133 g/s
road dust emission	0.000045 g/s chrome

0.000045 g/s is very small compared to an overall emission of 0.0133 g/s given that there is a margin of compliance of 27.6% .

EMISSION SUMMARY TABLE

Contaminant	CAS	Maximum Emission Rate	Annual Emission	POI Concentration	MOE Criteria	
		(g/s)	(kg)	(ug/m^3)	(ug/m^3)	
Total Suspended Particulate		0.508	7457	9.8	100	9.8%
PM-10		0.189	4080	3.9		
Chromium	7440-47-3	0.192	2690	3.62	5	72.4%
Magnesium Oxide	1309-48-4	0.0034	32	0.642	100	0.6%
Ferric Oxide	1309-37-1	0.0087	83	1.648	75	2.2%
Aluminum Oxide	1344-28-1	0.0045	43	0.852	100	0.9%
Hexavalent chromium		0.004865	105	0.102		
Ethyl benzene	100-41-4	0.0069	25	0.144	4000	0.0%
Naphthalene	91-20-3	0.0005	2	0.0105	36	0.0%
Xylenes	1330-20-7	0.0005	2	0.0105	2300	0.0%
Formaldehyde	50-00-0	0.00058	2	0.0122	65	0.0%
Toluene	108-88-3	0.007	25	0.146	2000	0.0%
Benzene	71-43-2	0.013	47	0.271		
Nitrogen oxides (See NOx)	10102-44-0	0.132	1968	2.57	500	0.5%

EMISSION SUMMARY AND DISPERSION MODELLING REPORT CHECK-LIST

Company Name: _____

Company Address: _____

_____

_____

Location of Facility: _____

_____

Company Contact:. _____

Phone Number: _____

The attached Emission Summary and Dispersion Modelling Report was prepared in accordance with the guidance in the Procedure for preparing an Emission Summary and Source Modelling Report and the minimum required information identified in the check-list on the reverse of this sheet has been submitted

Name: _____

Representing: _____

Phone Number: _____

Signature: _____

Date: _____

EMISSION SUMMARY AND DISPERSION MODELLING REPORT CHECK-LIST

Minimum Required Information	Submitted		
	Yes	No	
1. Facility Description			
General description of the facility;			
Process flow diagram			
Site plan, drawn to scale			
Elevation view or the heights above grade of all the buildings are clearly identified in the plan view;			
Locations of nearby receptors (if any of the emission stacks are configured as a Point Source)			
2. Completed Source Summary Table			
Source data, including an identifier and a listing of general information for each emission source;			
Estimate of the maximum emission rate, for every contaminant emitted,			
Assessment of data quality;			
Reference to the emission estimating technique			
Percentage of overall emission			
3. Completed Emission Summary Table			
Contaminant name;			
CAS number;			
Aggregate half-hour emission rate for each contaminant			
Aggregate annual emission rate for each contaminant (optional)			
Aggregate maximum point of impingement concentration, in micrograms per cubic metre (ug/m^3);			
Half-hour Point of Impingement Limit, in micrograms per cubic metre (ug/m^3);			
Percentage of Criteria			
4. Dispersion modelling output			
5. Description of the maximum emission scenario on which emissions are reported			

Note: Shaded portion is for Ministry of the Environment use only.